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AIR QUALITY

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

AIR QUALITY

January 2023

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Air quality

Air quality problems such as smog and acid rain result from the release of pollutants into the atmosphere. The majority of these pollutants come from human activities, such as transportation, the burning of fuels for electricity and heating, and industry. Pollutants from natural sources, such as wildfires, can sometimes be substantial. Air pollutants cause adverse health and environmental effects. The Air quality indicators present the concentrations of 5 key air pollutants for Canada.

National air quality trends

This section presents a summary of outdoor air quality trends for 5 air pollutants averaged across monitoring stations in Canada: fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and volatile organic compounds (VOCs). Air quality trends are measured by average[1] and peak[2] ambient levels (concentrations) of $PM_{2.5}$, O_3, NO_2, SO_2 and VOCs.[3] Average concentrations capture chronic, prolonged or repeated exposure to air pollutants over longer time periods, while peak concentrations capture immediate or acute short-term exposure to air pollutants.

Key results

Between 2005 and 2019,

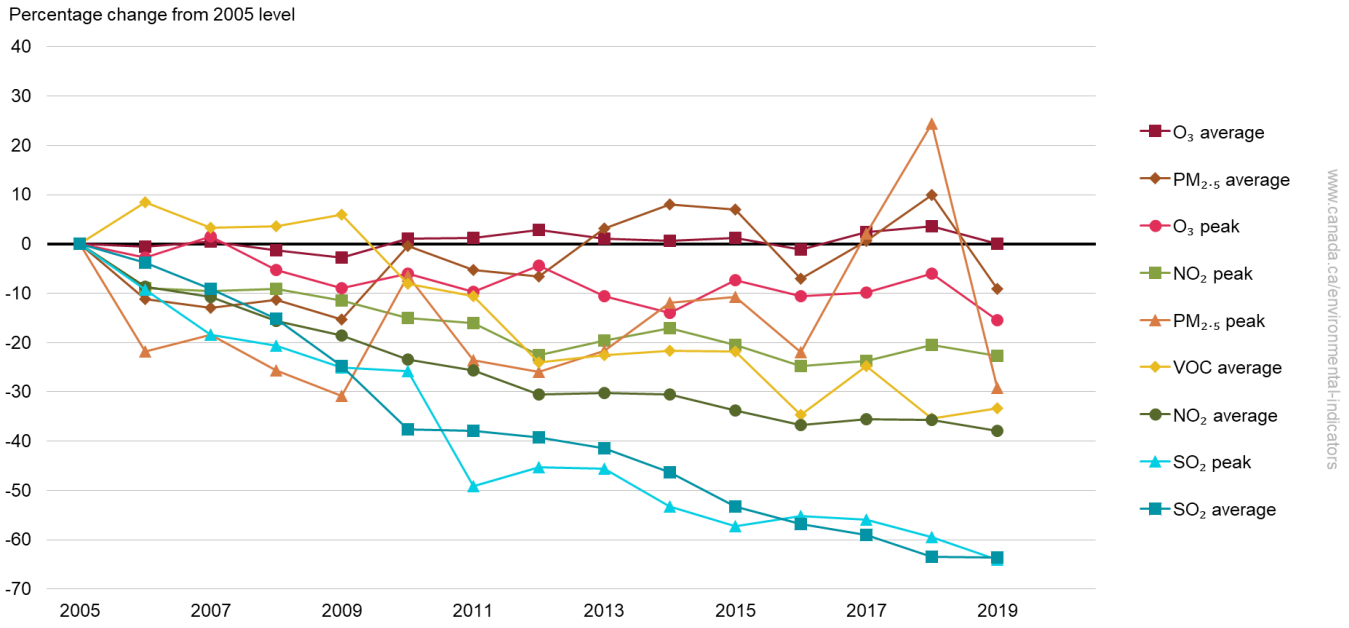
- average $PM_{2.5}$ concentrations have remained mostly unchanged with slight year-to-year fluctuations and a dip in 2019
- peak $PM_{2.5}$ concentrations exhibited variable results, decreasing after 2005 but trending upward over the past decade and decreasing again in 2019
- average O_3 concentrations fluctuated above and below 2005 levels, while peak O_3 concentrations have generally decreased
- average and peak NO_2, SO_2 and average VOC concentrations have decreased steadily

[1] Average concentrations refer to the annual average of the daily 24-hour average concentrations for $PM_{2.5}$, the annual average of the daily maximum 8-hour average concentrations for O_3, the annual average of the hourly concentrations for NO_2 and SO_2 and the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) for VOCs.

[2] Peak concentrations refers to the annual 98th percentile of the daily 24-hour average concentrations for $PM_{2.5}$, the annual 4th-highest of the daily maximum 8-hour average concentrations for O_3, the annual 98th percentile of the daily maximum 1-hour average concentrations for NO_2 and the annual 99th percentile of the daily maximum 1-hour average concentrations for SO_2.

[3] Only average VOC concentrations are measured.

Figure 1. Relative air pollutant concentration changes, Canada, 2005 to 2019



Data for Figure 1

Note: For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Nationally, in 2019, the average $PM_{2.5}$ concentration was 9% lower than in 2005, while the peak $PM_{2.5}$ concentration was 29% lower. In 2018, high wildfire activity in western Canada resulted in record-high average and peak $PM_{2.5}$ concentrations. From 2018 to 2019, the average $PM_{2.5}$ concentration decreased 17%, while the peak $PM_{2.5}$ concentration decreased 43%.

In 2019, the national average O_3 concentration was unchanged from 2005, while the peak O_3 concentration was 15% lower than in 2005.

Between 2005 and 2019, decreasing concentrations were measured for the following:

- average NO_2 was 38% lower
- peak NO_2 was 23% lower
- average SO_2 was 64% lower
- peak SO_2 was 64% lower

From 2006 to 2009, national VOC concentrations were higher than in 2005. From 2010 forward, concentrations remained below the 2005 concentration. In 2019, the average VOC concentration was 33% lower than in 2005.

The concentrations of these pollutants in outdoor air are influenced by many factors, including the proximity to local emission sources, weather conditions, chemical reactions in the air and the transboundary transport of air pollutants over long distances by wind. Part of the increase in $PM_{2.5}$ concentrations recorded since 2009 may be due to the progressive introduction of monitoring equipment featuring newer technologies. An increase in wildfire activity over the past decade has increased average and peak $PM_{2.5}$ concentrations, especially in western Canada.

Fine particulate matter

Fine particulate matter ($PM_{2.5}$) is emitted to the air and can also be formed in the air through the interactions of other pollutants, such as nitrogen oxides, sulphur oxides, ammonia and volatile organic compounds. The particles can be in solid or liquid form. Fine particulate matter is one of the major components of smog. When inhaled deeply into the lungs, even small amounts of $PM_{2.5}$ can cause adverse health effects. Exposure to $PM_{2.5}$ can lead to respiratory and cardiovascular effects, such as asthma attacks, chronic bronchitis, heart attacks as well as lung

cancer. Fine particulate matter can also damage vegetation and structures, contribute to haze and reduce visibility.

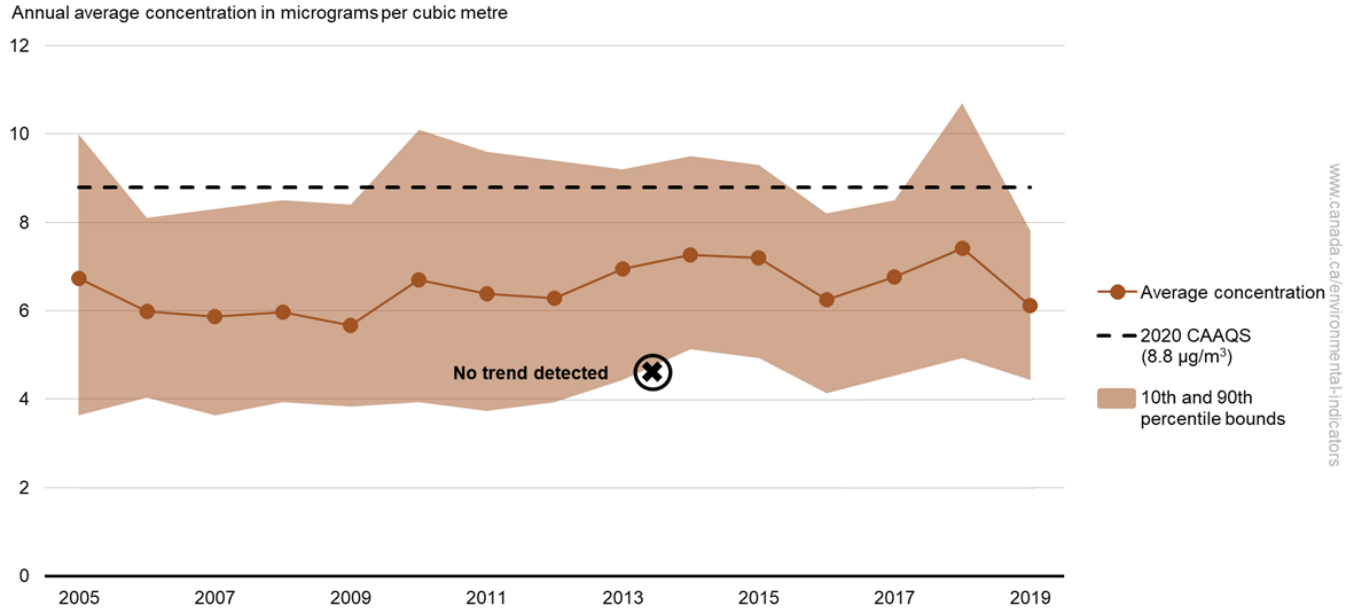
National average fine particulate matter concentrations[4]

Key results

Between 2005 and 2019,

- no trend was detected in the national average $PM_{2.5}$ concentrations
- national average concentrations remained below the 2020 standard[5] of 8.8 micrograms per cubic metre (µg/m^3) for all years; however, concentrations at some monitoring stations exceeded the standard in some years

Figure 2. National average fine particulate matter concentrations, Canada, 2005 to 2019



Data for Figure 2

Note: The national average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 145 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of average $PM_{2.5}$ concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the national average $PM_{2.5}$ concentration was 6.1 µg/m^3, which was 17% (1.3 µg/m^3) lower than in 2018. In 2018, the higher concentrations can be attributed in part to wildfire activity in western Canada. From 2005 to 2019, national concentrations decreased by 9% (0.6 µg/m^3).

Changes in average $PM_{2.5}$ concentrations may be related to changes in the quantity of emissions and to annual variations in weather conditions. Weather conditions influence the formation, dispersion and regional transport of $PM_{2.5}$ as well as transboundary movement of $PM_{2.5}$, such as from the United States. The variations observed in

[4] Average concentrations refer to the annual average of the daily 24-hour average concentrations.

[5] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

average $PM_{2.5}$ concentrations were also influenced by the progressive introduction of monitoring equipment that uses newer measurement technologies.

From the mid-2000s to 2013, new $PM_{2.5}$ monitoring equipment was progressively introduced across Canada to replace older monitoring equipment. These new instruments measure an additional portion (semi-volatile) of the $PM_{2.5}$ mass not captured by the older instruments. Concentrations measured with the new monitors may not be directly comparable with measurements from years in which older instruments were used.

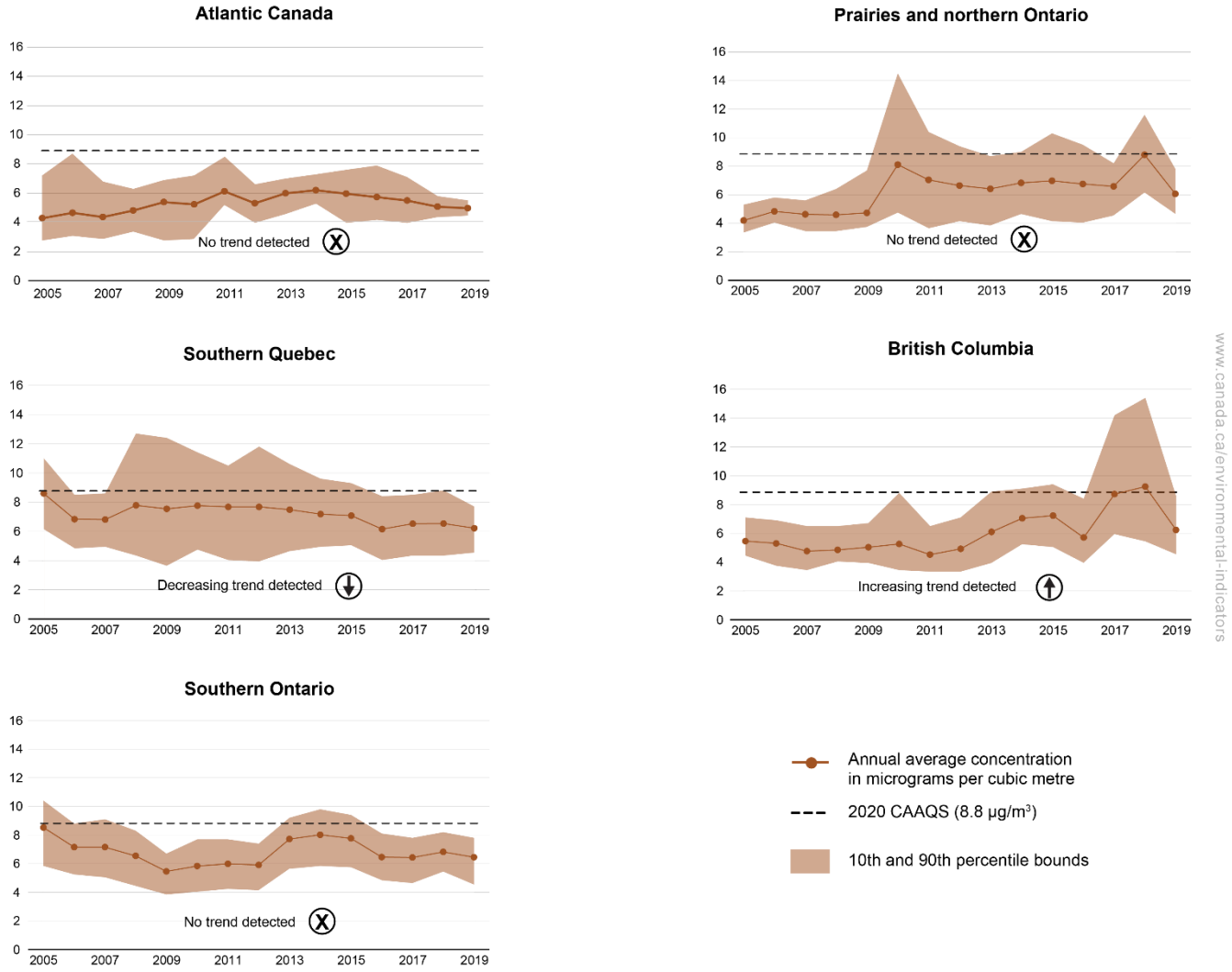
Regional average fine particulate matter concentrations

Key results

- Between 2005 and 2019,
  - increasing trends were detected for average $PM_{2.5}$ concentrations in the British Columbia region
  - a decreasing trend was detected in the southern Quebec region
  - no trends were detected for the Atlantic Canada, southern Ontario and the Prairies, and northern Ontario regions
- Since 2005, average $PM_{2.5}$ concentrations have remained below the 2020 standard[6] of 8.8 µg/m^3 across all regions of Canada, with the exception of British Columbia in 2018; however, concentrations at some monitoring stations in 4 regions exceeded the standard in various years

[6] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Figure 3. Regional average fine particulate matter concentrations, Canada, 2005 to 2019



Data for Figure 3

Note: The regional average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 11 monitoring stations in Atlantic Canada, 36 in southern Quebec, 39 in southern Ontario, 33 in the Prairies and northern Ontario region and 24 in British Columbia. There were not enough stations to report results for the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standards is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of average $PM_{2.5}$ concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the southern Ontario region had the highest regional average $PM_{2.5}$ concentration, at 6.4 µg/m^3. The southern Quebec and British Columbia regions each reported a concentration of 6.2 µg/m^3.The Prairies and northern Ontario region followed with a concentration of 6.1 µg/m^3. The Atlantic Canada region had the lowest regional average concentration, at 5.0 µg/m^3.

All 5 regions had lower concentrations in 2019 than in 2018. Between 2018 and 2019, the British Columbia and Prairies and northern Ontario regions had the largest reductions in concentrations, with decreases of 33% (3.0 µg/m^3) and 31% (2.7 µg/m^3), respectively. The average $PM_{2.5}$ concentration peaked in these 2 regions in 2018 primarily due to increased wildfire activity. British Columbia was also affected by wildfire activity in 2017. From 2018 to 2019, the southern Ontario, southern Quebec and Atlantic Canada regions had reductions of 6%, 5% and 2%, respectively.

Between 2005 and 2019,

- a decreasing trend of 0.1 µg/m^3 per year was detected for the southern Quebec region
    - concentrations decreased by 28% (2.4 µg/m^3)
- an increasing trend of 0.2 µg/m^3 per year was detected for British Columbia
    - concentrations increased by 14% (0.8 µg/m^3)
- no trends were detected for the Atlantic Canada, southern Ontario and the Prairies and northern Ontario regions

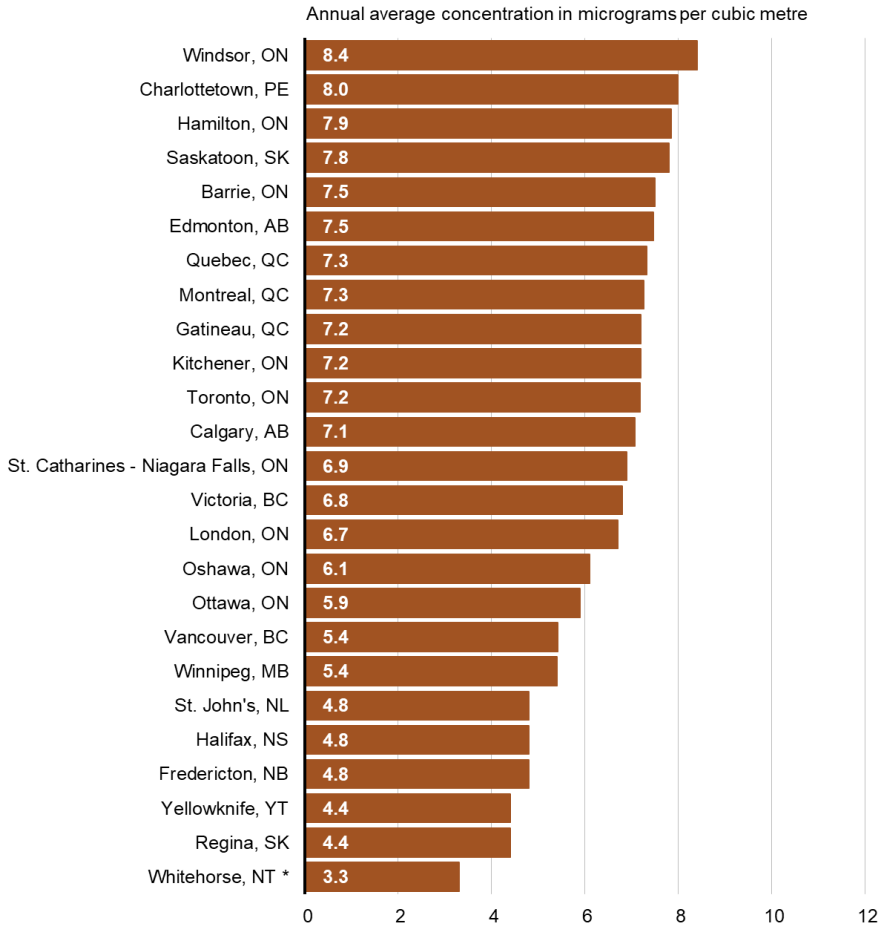
Average fine particulate matter concentrations in urban areas

Key results

In 2019, among the selected urban areas

- Windsor and Charlottetown had the highest average $PM_{2.5}$ concentrations
- Whitehorse,[7] Regina and Yellowknife had the lowest concentrations

Figure 4. Average fine particulate matter concentrations, selected Canadian urban areas, 2019



Data for Figure 4

Note: * The concentration presented in the figure for Whitehorse was from 2018. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information. All concentrations available since 2005 for each urban areas are presented in the data table for this figure.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Average $PM_{2.5}$ concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to differences in emissions of pollutants, variations in weather conditions that influence $PM_{2.5}$ formation, dispersion and regional transport and variations in transboundary flows of pollution, primarily from the United States. Exceptional events, such as wildfires, can also impact average $PM_{2.5}$ concentrations measured in urban areas.

[7] The 2019 concentration reported for Whitehorse was from 2018.

Average fine particulate matter concentrations at monitoring stations

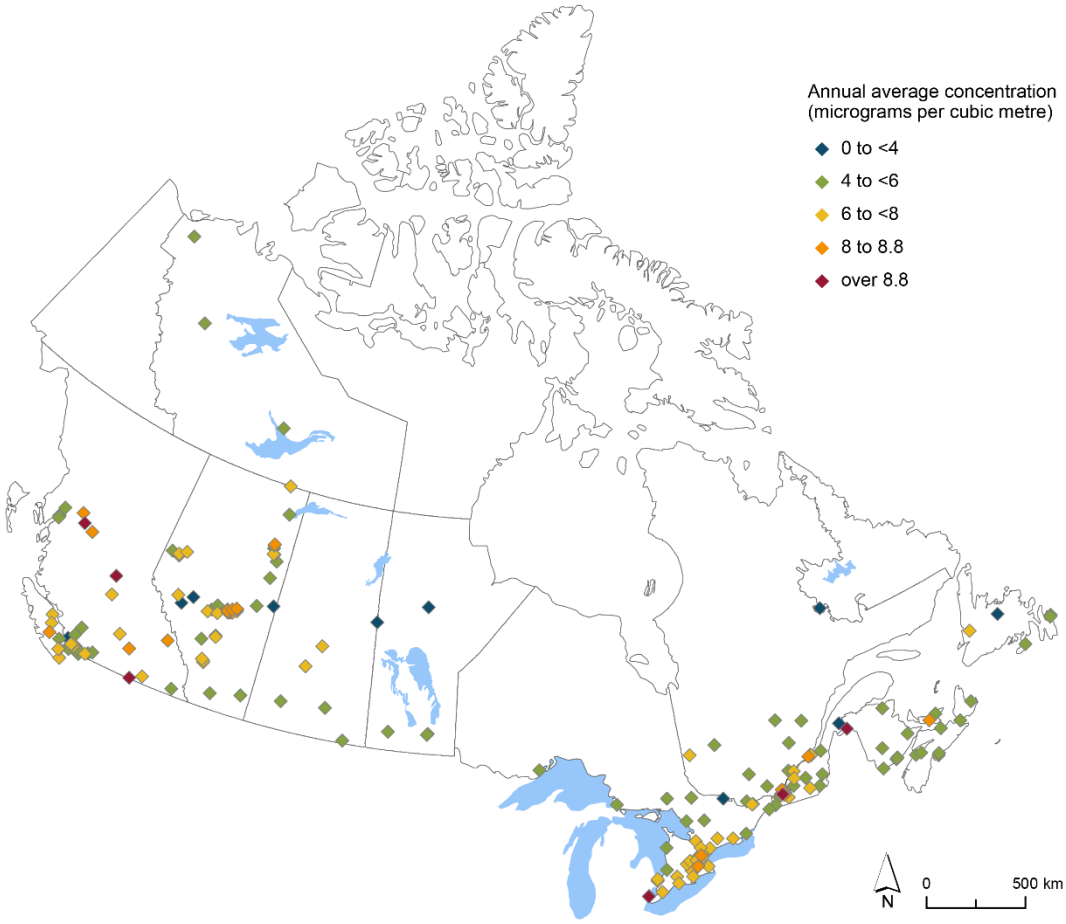
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore average $PM_{2.5}$ concentrations at specific monitoring stations.

In 2019, average $PM_{2.5}$ concentrations were recorded at 205 monitoring stations across Canada. Average $PM_{2.5}$ concentrations varied across monitoring stations.

- 6 stations recorded concentrations above 8.8 µg/m^3
  - A single station in each New Brunswick, Quebec and Ontario and 3 stations located in British Columbia had concentrations between 8.9 µg/m^3 and 10.6 µg/m^3
- 11 stations recorded below 4.0 µg/m^3. Of these stations, 2 were located in Newfoundland and Labrador, 1 each in Quebec and Ontario, 2 were in Manitoba, 3 were in Alberta and 2 were located in British Columbia

Figure 5. Average fine particulate matter concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

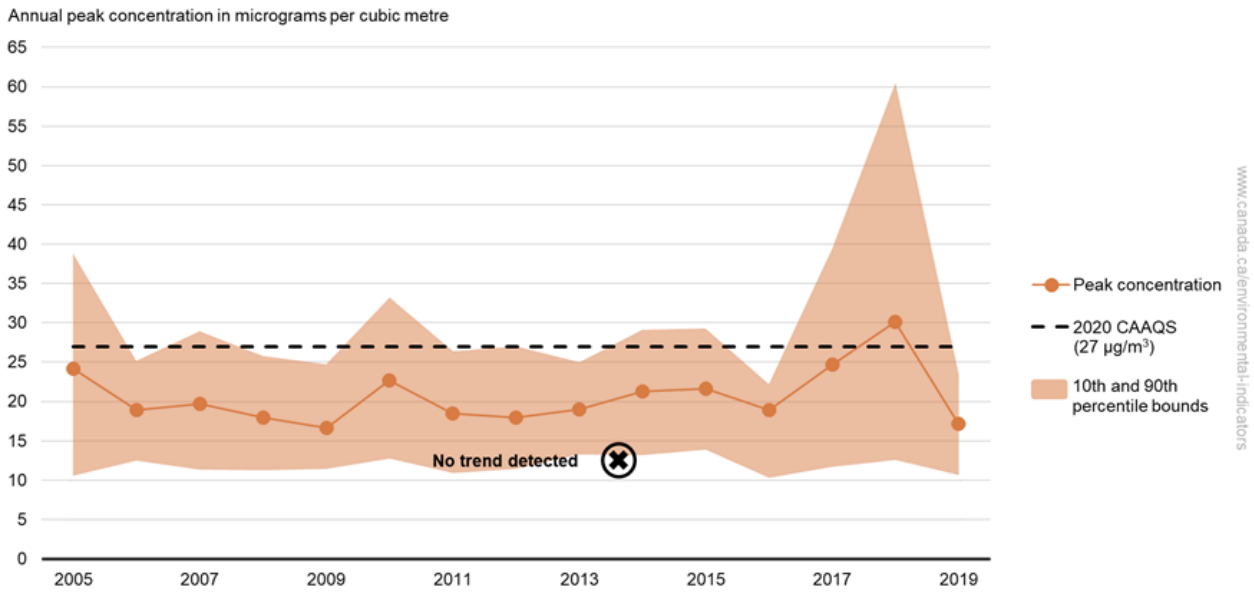
National peak fine particulate matter concentrations[8]

Key results

Between 2005 and 2019,

- no trend was detected in the peak $PM_{2.5}$ concentrations
- national peak concentrations remained below the 2020 standard[9] of 27 µg/m^3 for all years except 2018; however, concentrations at some monitoring stations exceeded the standard in some years

Figure 6. National peak fine particulate matter concentrations, Canada, 2005 to 2019



Data for Figure 6

Note: The national peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 147 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak $PM_{2.5}$ concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the national peak $PM_{2.5}$ concentration was 17.1 µg/m^3, which was 43% (12.9 µg/m^3) lower than in 2018. In 2017 and 2018, the higher concentrations can be attributed primarily to wildfire activity in western Canada. From 2005 to 2019, national concentrations decreased by 29% (7.1 µg/m^3).

Changes in peak $PM_{2.5}$ concentrations may be related to changes in the quantity of emissions and to annual variations in weather conditions. Weather conditions influence the formation, dispersion and regional transport of $PM_{2.5}$ as well as transboundary movement of $PM_{2.5}$, such as from the United States. The variations observed in peak $PM_{2.5}$ concentrations were also influenced by the progressive introduction of monitoring equipment that uses newer measurement technologies.

From the mid-2000s to 2013, new $PM_{2.5}$ monitoring equipment was progressively introduced across Canada to replace older monitoring equipment. These new instruments measure an additional portion (semi-volatile) of the

[8] Peak concentrations refers to the annual 98th percentile of the daily 24-hour average concentrations.

[9] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

$PM_{2.5}$ mass not captured by the older instruments. Concentrations measured with the new monitors may not be directly comparable with measurements from years in which older instruments were used.

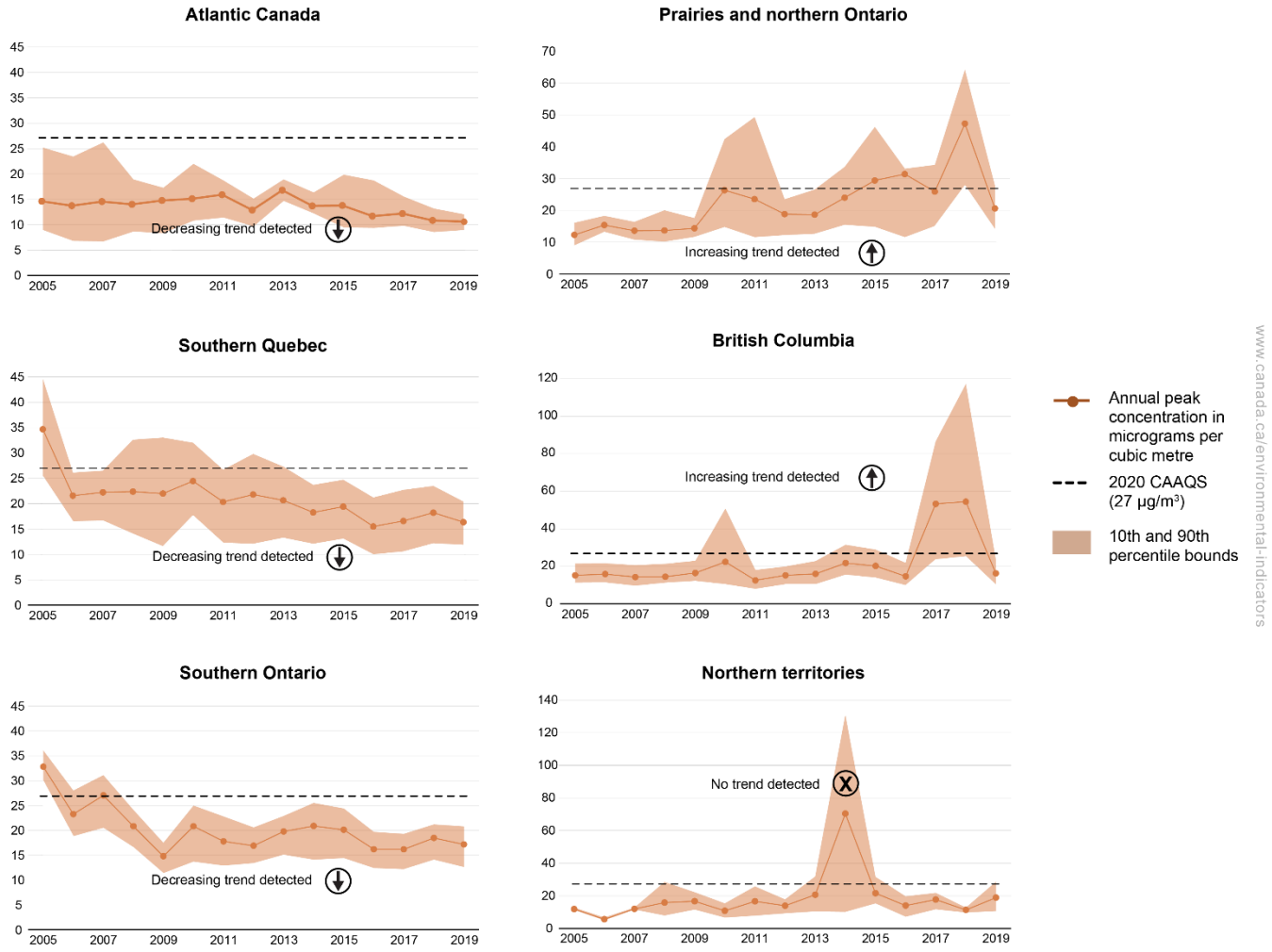
Regional peak fine particulate matter concentrations

Key results

- Between 2005 and 2019,
  - increasing trends were detected for peak $PM_{2.5}$ concentrations in the Prairies and northern Ontario and British Columbia regions
  - decreasing trends were detected in the Atlantic Canada, southern Quebec and southern Ontario regions
  - no trend was detected for the northern territories region
- Since 2005, regional peak $PM_{2.5}$ concentrations have exceeded the 2020 standard[10] of 27 µg/m^3 at least once in all regions of Canada, with the exception of Atlantic Canada. Further, with the exception of Atlantic Canada, concentrations at some monitoring stations in all other regions exceeded the standard in various years

[10] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Figure 7. Regional peak fine particulate matter concentrations, Canada, 2005 to 2019



Data for Figure 7

Note: The regional peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 11 monitoring stations in Atlantic Canada, 36 in southern Quebec, 39 in southern Ontario, 33 in the Prairies and northern Ontario region, 25 in British Columbia and 3 in the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak $PM_{2.5}$ concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the Prairies and northern Ontario region had the highest regional peak $PM_{2.5}$ concentration, at 20.6 µg/m^3. The Atlantic Canada region had the lowest regional peak concentration, at 10.9 µg/m^3.

The regional peak concentration was lower in 2019 than in 2018 in all regions except in the northern territories region. Between 2018 and 2019, the British Columbia and Prairies and northern Ontario regions had the largest reductions in concentrations, with decreases of 70% (38.3 µg/m^3) and 56% (26.6 µg/m^3), respectively. The average $PM_{2.5}$ concentration peaked in these 2 regions in 2018 in part due to increased wildfire activity. British Columbia was also affected by wildfire activity in 2017. From 2018 to 2019, the southern Quebec, southern Ontario and Atlantic Canada regions had concentration reductions of 10%, 7% and 2%, respectively. The northern territories region was the only region reporting an increase between 2018 and 2019, at 66% (7.5 µg/m^3).

Between 2005 and 2019,

- an increasing trend of 1.4 µg/m^3 per year was detected for the Prairies and northern Ontario region
    - concentrations increased by 68% (8.3 µg/m^3)

- an increasing trend of 0.5 µg/m^3 per year was detected for British Columbia
    - concentrations increased by 7% (1.0 µg/m^3).
- a decreasing trend of 0.6 µg/m^3 per year was detected for the southern Quebec region
    - concentrations decreased by 53% (18.3 µg/m^3)
- a decreasing trend of 0.6 µg/m^3 per year was detected for the southern Ontario region
    - concentrations decreased by 48% (15.6 µg/m^3)
- a decreasing trend of 0.3 µg/m^3 per year was detected for the Atlantic Canada region
    - concentrations decreased by 26% (3.9 µg/m^3)
- no trend was detected for the northern territories region

Regional peak $PM_{2.5}$ concentrations tend to exceed the standard in years with increased wildfire activity.

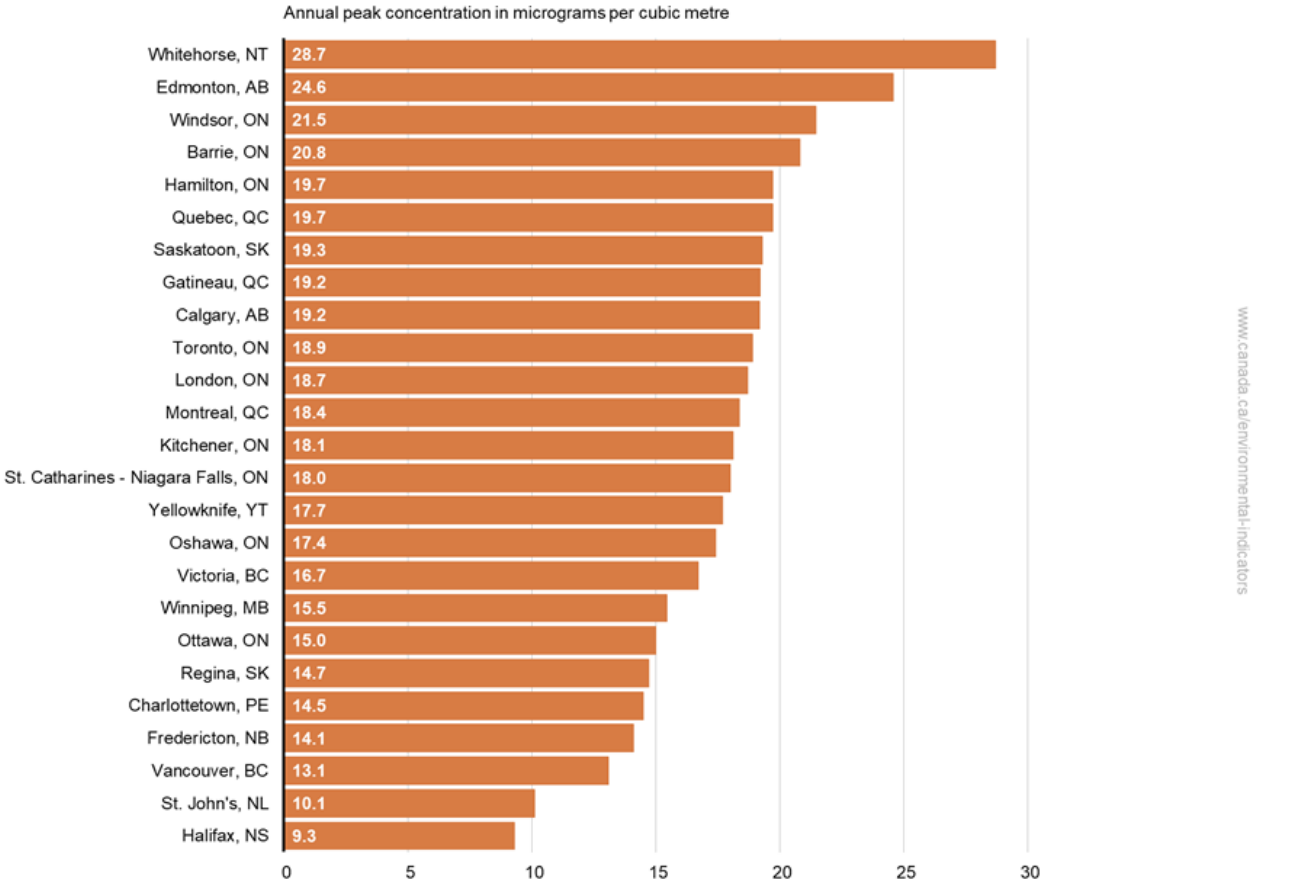
Peak fine particulate matter concentrations in urban areas

Key results

In 2019, among the selected urban areas

- Whitehorse and Edmonton had the highest peak $PM_{2.5}$ concentrations
- Halifax and St. John's had the lowest concentrations

Figure 8. Peak fine particulate matter concentrations, selected Canadian urban areas, 2019



Data for Figure 8

Note: Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information. All concentrations available since 2005 for each urban areas are presented in the data table for this figure.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Peak $PM_{2.5}$ concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to differences in emissions of pollutants, variations in weather conditions that influence $PM_{2.5}$ formation, dispersion and regional transport, as well as variations in transboundary flows of pollution, primarily from the United States. Exceptional events, such as wildfires, can also have a significant influence on the peak $PM_{2.5}$ concentrations in urban areas.

Peak fine particulate matter concentrations at monitoring stations

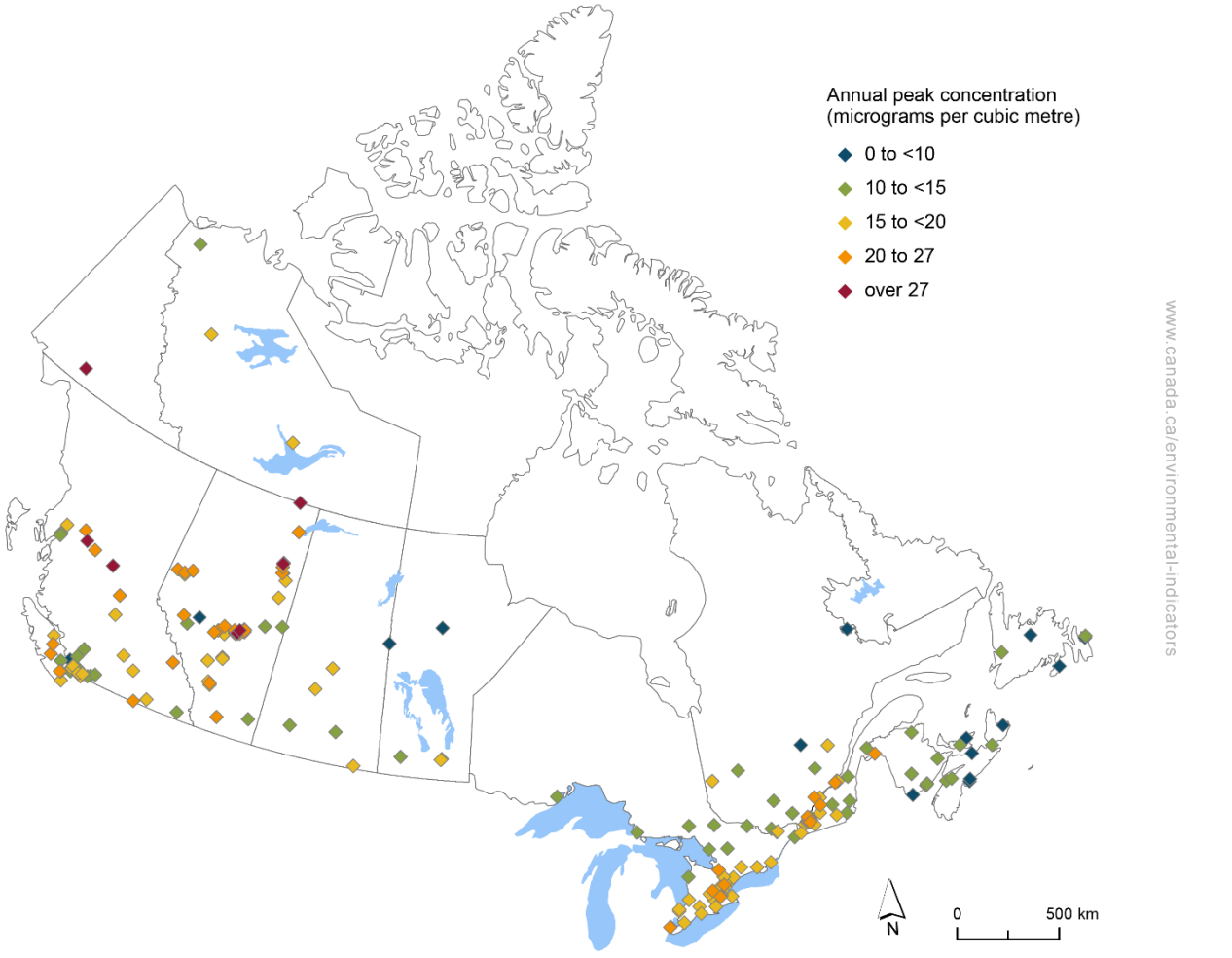
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore peak $PM_{2.5}$ concentrations at specific monitoring stations.

In 2019, peak $PM_{2.5}$ concentrations were recorded at 207 monitoring stations across Canada. The highest peak $PM_{2.5}$ concentrations were generally recorded at monitoring stations in western Canada.

- 8 stations recorded concentrations above 27.0 µg/m^3, ranging from 27.7 µg/m^3 to 34.5 µg/m^3. Of these stations, 4 were in Alberta, 2 were in British Columbia and 1 each in Yukon and the Northwest Territories
- 18 stations recorded concentrations below 10.0 µg/m^3. Of these stations, 4 were located in Newfoundland and Labrador, 1 was in Prince Edward Island, 4 were in Nova Scotia, 1 each in New Brunswick, Quebec and Alberta, 2 were in Manitoba and 4 were located in British Columbia

Figure 9. Peak fine particulate matter concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Ground-level ozone

Ozone (O_3) in the upper atmosphere (10 to 50 kilometres above the earth's surface) protects the earth from the sun's harmful ultraviolet radiation. In the lower atmosphere and at ground level, O_3 is harmful to human health. It can lead to throat irritation, coughing, shortness of breath and reduced lung function, and also aggravate existing conditions, such as asthma or other chronic lung diseases. Ground-level O_3 can also impact vegetation, decrease the productivity of some crops and may contribute to forest decline. It can also damage synthetic materials and textiles, cause cracks in rubber, accelerate fading of dyes and speed deterioration of some paints and coatings. Ozone is not directly emitted, but is formed in the lower atmosphere when precursor gases such as nitrogen oxides and volatile organic compounds react in sunlight. Ground-level O_3 is a major component of smog, along with fine particulate matter.

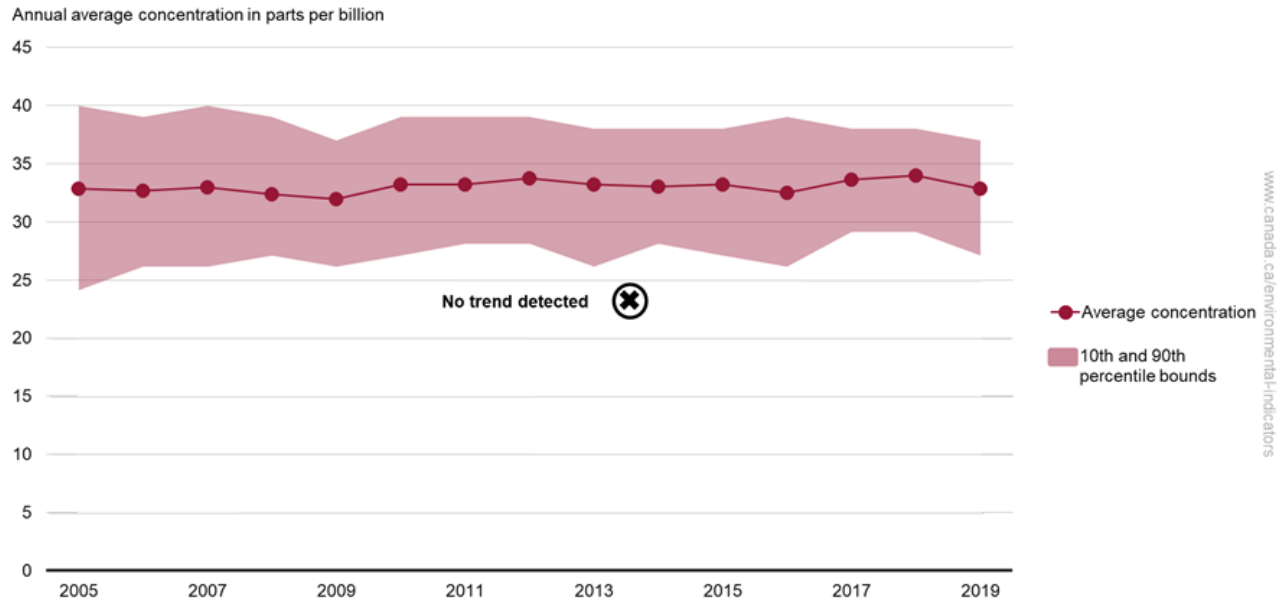
National average ground-level ozone concentrations[11]

Key results

Between 2005 and 2019,

- no trend was detected in the national average O_3 concentrations
- national average concentrations remained stable

Figure 10. National average ozone concentrations, Canada, 2005 to 2019



Data for Figure 10

Note: The national average O_3 concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 171 monitoring stations across Canada. The shaded area shows the 10th and 90th percentile bounds of average O_3 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

In 2019, the national average O_3 concentration was 33 parts per billion (ppb), which was 3% (1 ppb) lower than in 2018. From 2005 to 2019, national concentrations were relatively unchanged.

[11] Average concentrations refer to the annual average of the daily maximum 8-hour average concentrations.

Regional average ground-level ozone concentrations

Key results

- Between 2005 and 2019,
  - an increasing trend was detected for average O_3 concentrations in the southern Quebec region
  - no trends were detected for any other region
- Since 2005, regional average O_3 concentrations have remained fairly steady in all regions of Canada; however, concentrations at some monitoring stations fluctuated over the years

Figure 11. Regional average ozone concentrations, Canada, 2005 to 2019

Data for Figure 11

Note: The regional average O_3 concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 21 monitoring stations in Atlantic Canada, 41 in southern Quebec, 42 in southern Ontario, 34 in the Prairies and northern Ontario region, 30 in British Columbia and 3 in the northern territories region. The shaded area shows the 10th and 90th percentile bounds of average O_3 concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

In 2019, the southern Ontario region had the highest regional average O_3 concentration, at 36 ppb. The Atlantic Canada and southern Quebec regions each had a concentration of 34 ppb, while the Prairies and northern Ontario and northern territories regions reported concentrations of 33 ppb and 32 ppb, respectively. The British Columbia region had the lowest regional average concentration, at 27 ppb.

The regional average concentration was lower in 2019 than in 2018 in all regions except in the northern territories region. Between 2018 and 2019, the Prairies and northern Ontario and British Columbia regions had the largest reduction in concentrations, with decreases of 5% (2 ppb) each. These decreases are likely due in part to reduced wildfire activity in western Canada in 2019. In addition to contributing to $PM_{2.5}$ concentrations, widfires also contribute to higher ozone levels. From 2018 to 2019, the southern Quebec region had a 3% reduction, while the southern Ontario and Atlantic Canada regions each had a 2% reduction. The northern territories region was the only region reporting an increase between 2018 and 2019. Concentrations in the region increased 2% (1 ppb).

Between 2005 and 2019, an increasing trend of 0.2 ppb per year was detected for the southern Quebec region. From 2005 to 2019, concentrations in southern Quebec increased by 1% (less than 1 ppb).

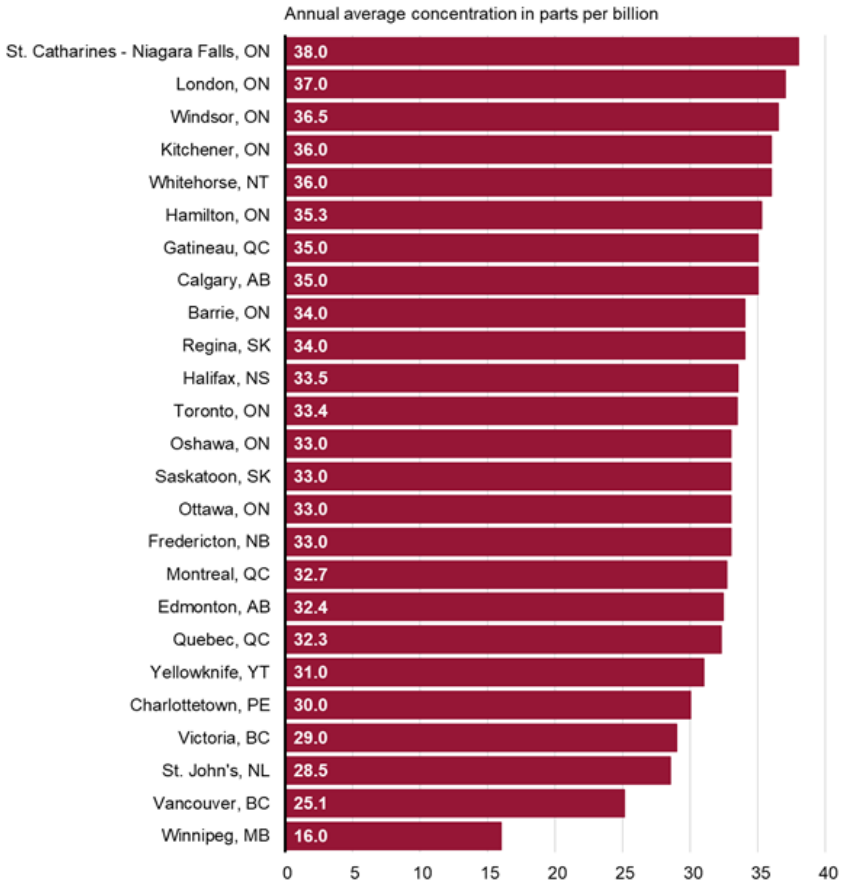
Average ground-level ozone concentrations in urban areas

Key results

In 2019, among the selected urban areas

- St. Catharines – Niagara Falls and London had the highest average O_3 concentrations
- Winnipeg, Vancouver and St. John's had the lowest concentrations

Figure 12. Average ozone concentrations, selected Canadian urban areas, 2019



Data for Figure 12

Note: Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information. All concentrations available since 2005 for each urban areas are presented in the data table for this figure.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Ground level ozone is a secondary pollutant that forms in the air through the chemical interactions of precursors. Annual average O_3 concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to variations in local emissions of O_3 precursors (mostly NO_X and VOCs), variations in weather conditions that influence O_3 formation and variations in transboundary flows of pollution, primarily from the United States.

Average ground-level ozone concentrations at monitoring stations

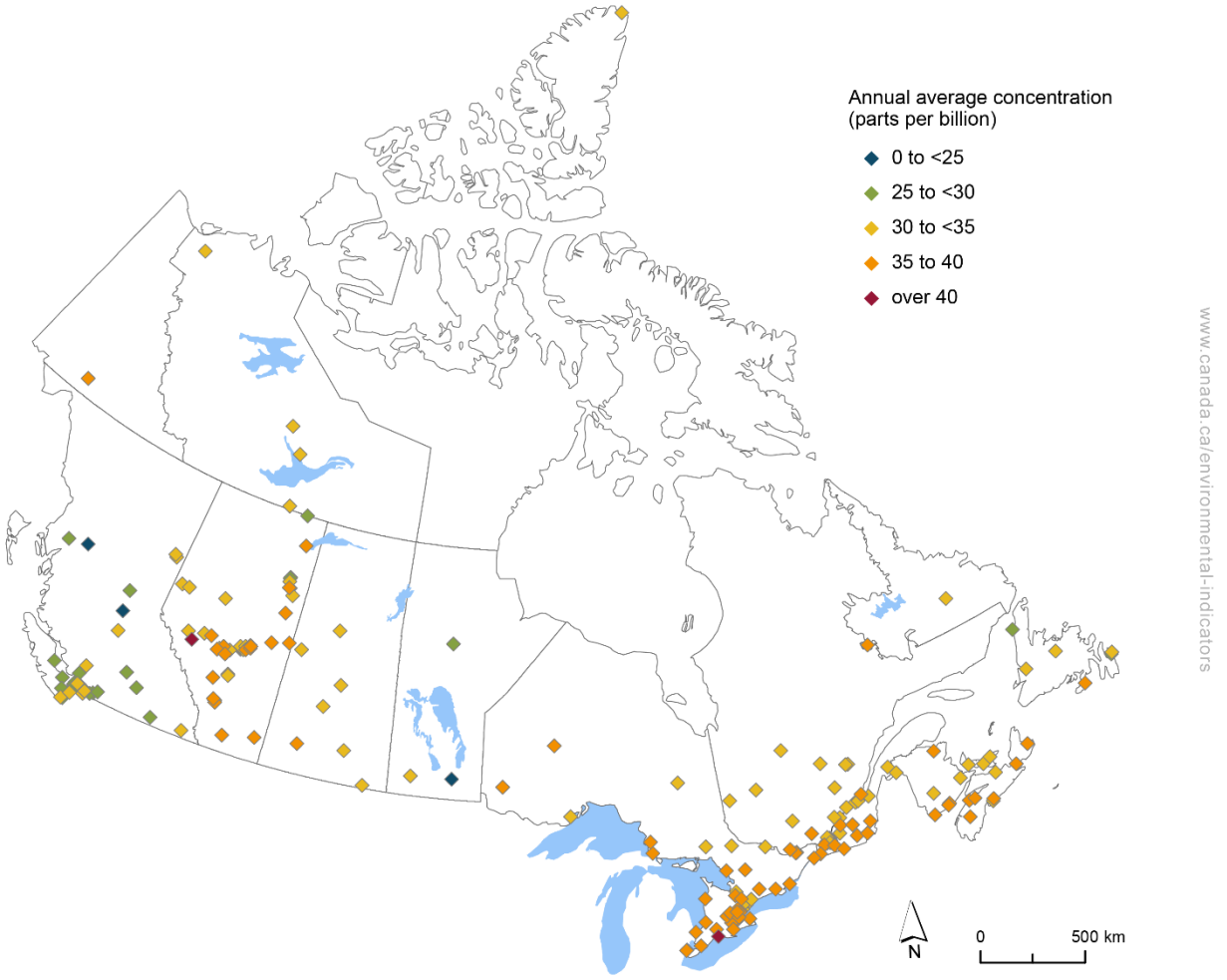
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore average O_3 concentrations at specific monitoring stations.

In 2019, average O_3 concentrations were recorded at 217 monitoring stations across Canada. Of these stations:

- 1 station located in Ontario had a concentration of 41 ppb
- 9 stations had concentrations below 25 ppb. Of these stations, 1 was located in Manitoba, the remaining 8 stations were all located in British Columbia

Figure 13. Average ozone concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

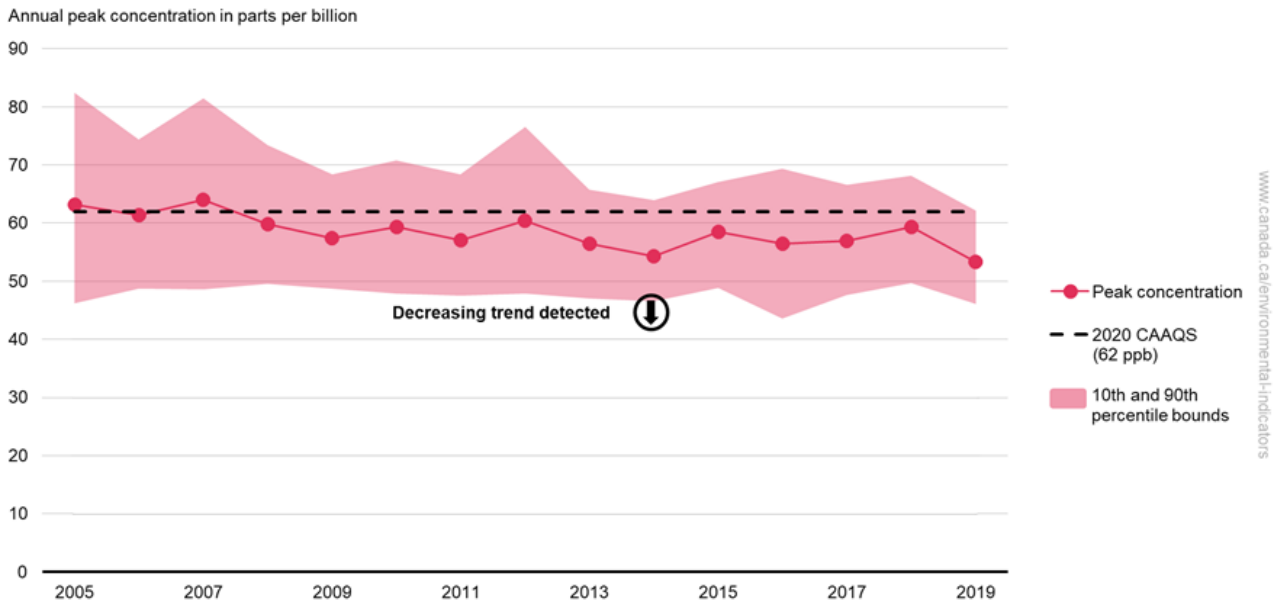
National peak ground-level ozone concentrations[12]

Key results

Between 2005 and 2019,

- a decreasing trend was detected in the peak O_3 concentrations
- national peak concentrations remained below the 2020 standard[13] of 62 ppb after 2007; however, concentrations at some monitoring stations exceeded the standard each year

Figure 14. National peak ozone concentrations, Canada, 2005 to 2019



Data for Figure 14

Note: The national peak O_3 concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 171 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak O_3 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

In 2019, the national peak O_3 concentration was 53 ppb, which was 10% (6 ppb) lower than in 2018. Between 2005 and 2019, a decreasing trend of 0.5 ppb per year was detected. From 2005 to 2019, national concentrations decreased by 15% (10 ppb). Reductions in Canadian and American emissions of ground-level O_3 precursor gases (nitrogen oxides [NO_X] and volatile organic compounds [VOCs]) are an important factor in this downward trend.

[12] Peak concentrations refers to the annual 4th-highest of the daily maximum 8-hour average concentrations.

[13] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Regional peak ground-level ozone concentrations

Key results

- Between 2005 and 2019,
  - decreasing trends were detected for peak O_3 concentrations in the Atlantic Canada, southern Quebec and southern Ontario regions
  - no trends were detected for the Prairies and northern Ontario, British Columbia and northern territories regions
- Since 2005, regional peak O_3 concentrations remained below the 2020 standard[14] of 62 ppb in all regions, with the exception of southern Quebec and southern Ontario. Further, with the exception of the northern territories region, concentrations at some monitoring stations in all other regions regularly exceeded the standard

Figure 15. Regional peak ozone concentrations, Canada, 2005 to 2019

Data for Figure 15

[14] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Note: The regional peak O_3 indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 21 monitoring stations in Atlantic Canada, 41 in southern Quebec, 42 in southern Ontario, 34 in the Prairies and northern Ontario region, 30 in British Columbia and 3 in the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak O_3 concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

In 2019, the southern Ontario region had the highest regional peak O_3 concentrations at 59 ppb. British Columbia and the northern territories region had the lowest peak O_3 concentration level, each reporting 46 ppb.

The regional average concentration was lower in 2019 than in 2018 in all regions. Between 2018 and 2019, the British Columbia region had the largest reduction in concentrations, with a decrease of 15% (8 ppb). This decrease is likely due in part to reduced wildfire activity in western Canada in 2019. From 2018 to 2019, the southern Ontario and southern Quebec regions had reductions of 12% (8 ppb) and 11% (6 ppb), respectively. The Atlantic Canada and northern territories regions each had a 6% reduction in concentrations, while concentrations for the Prairies and northern Ontario region decreased by 5% over the same period.

Between 2005 and 2019,

- a decreasing trend of 1.0 ppb per year was detected for the southern Ontario region
    - concentrations decreased by 28% (23 ppb)
- a decreasing trend of 0.6 ppb per year was detected for the southern Quebec region
    - concentrations decreased by 23% (15 ppb)
- a decreasing trend of 0.4 ppb per year was detected for the Atlantic Canada region
    - concentrations decreased by 7% (4 ppb)
- no trends were detected for the northern territories, British Columbia, and Prairies and northern Ontario regions

From 2005 to 2018, southern Ontario was the only region where regional peak O_3 concentrations were consistently above the 2020 standard. In 2019, concentrations dropped below the standard.

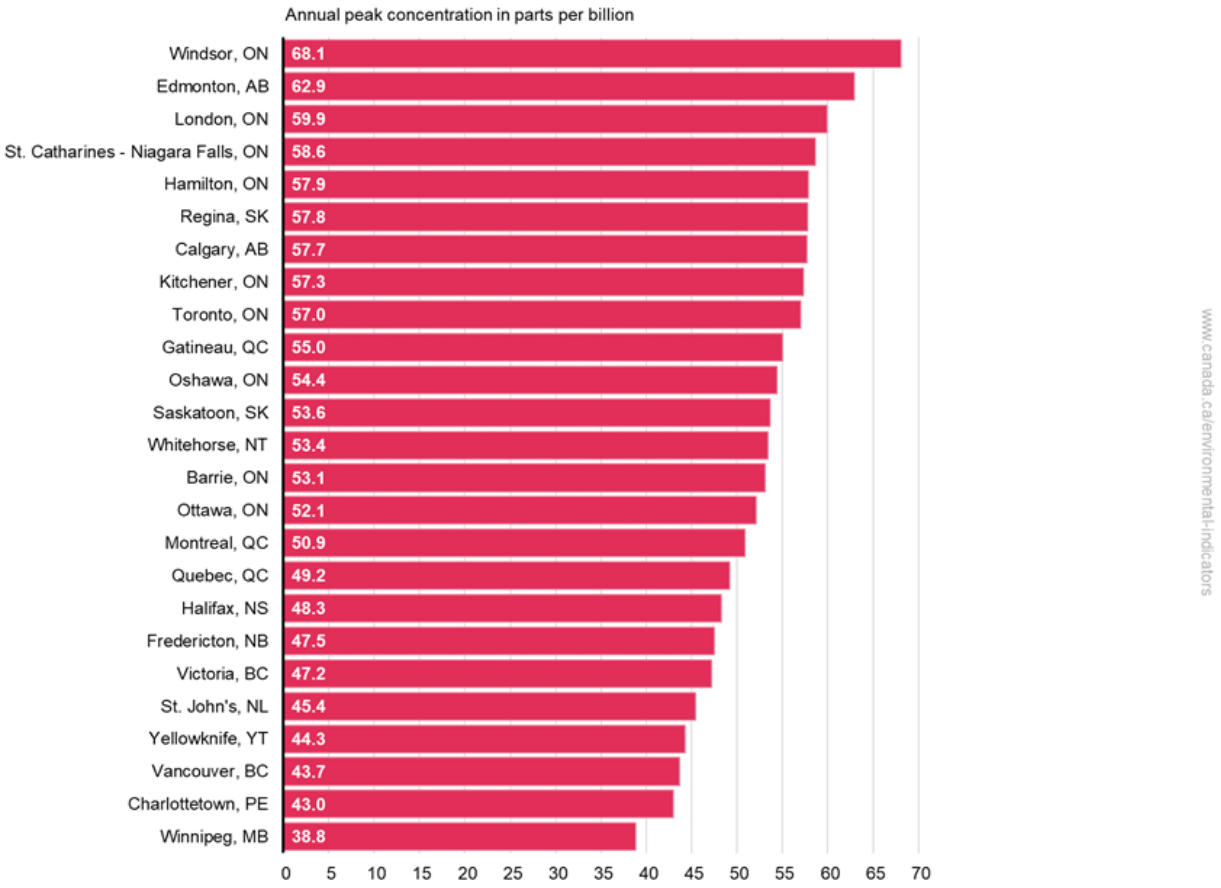
Peak ground-level ozone concentrations in urban areas

Key results

In 2019, among the selected urban areas

- Windsor and Edmonton had the highest peak O_3 concentrations
- Winnipeg, Charlottetown, Vancouver and Yellowknife had the lowest concentrations

Figure 16. Peak ozone concentrations, selected Canadian urban areas, 2019



Data for Figure 16

Note: Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information. All concentrations available since 2005 for each urban areas are presented in the data table for this figure.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Ground level ozone is a secondary pollutant that forms in the air through the chemical interactions of precursors. Peak ozone concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to variations in local emissions of O_3 precursors (mostly NO_X and VOCs), variations in weather conditions that influence O_3 formation and variations in transboundary flows of pollution, primarily from the United States.

Peak ground-level ozone concentrations at monitoring stations

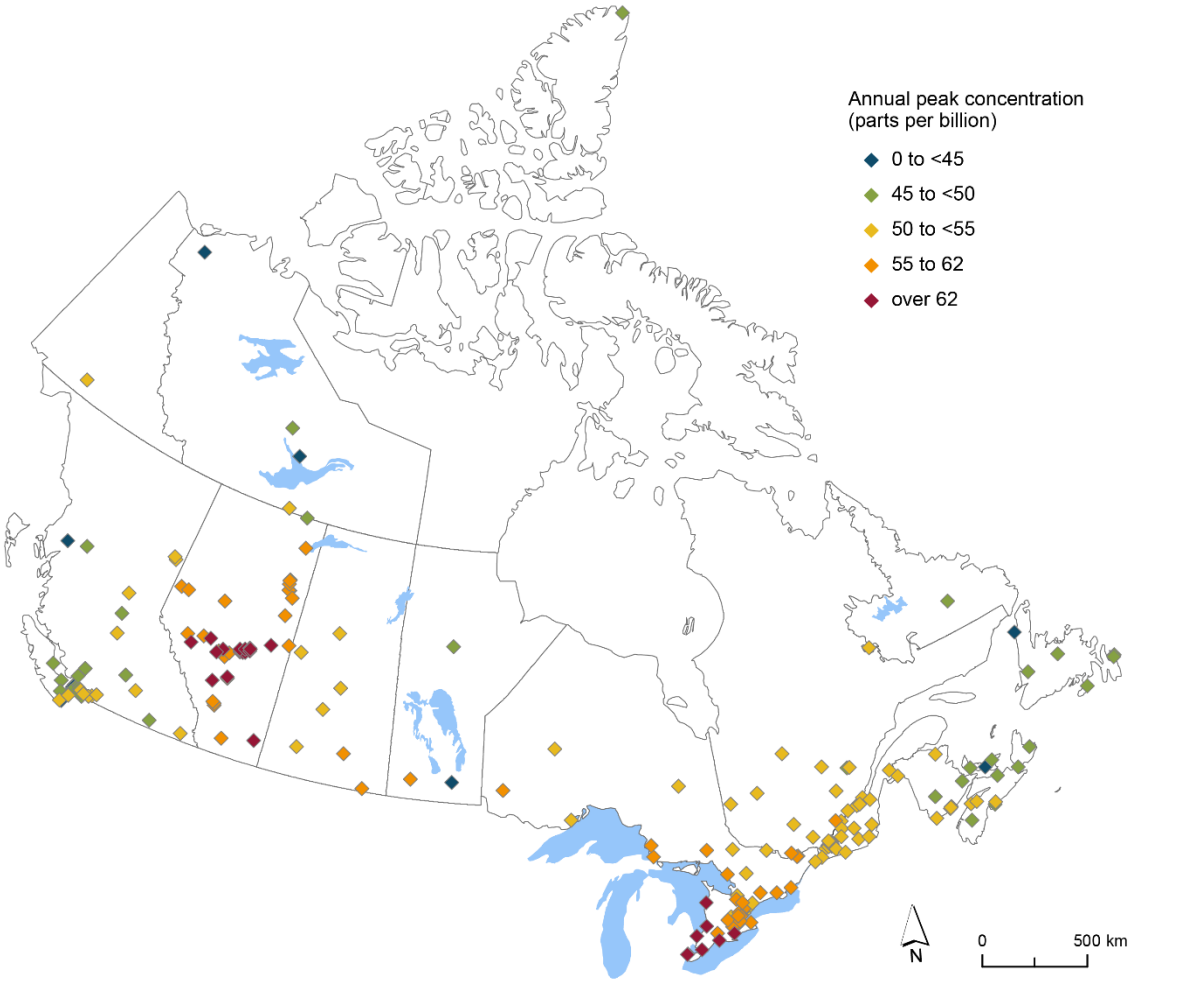
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore peak O_3 concentrations at specific monitoring stations.

In 2019, peak O_3 concentrations were recorded at 217 monitoring stations across Canada.

- 24 stations had concentrations over 62 ppb. Of these stations, 8 were located in Ontario and the remainder were located in Alberta
- 18 stations recorded concentrations below 45 ppb. Of these stations, 1 was located in Newfoundland and Labrador, 1 was located in Prince Edward Island, 1 was located in Manitoba, 13 were located in British Columbia and 2 were located in the Northwest Territories

Figure 17. Peak ozone concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Nitrogen dioxide

Nitrogen dioxide (NO_2) plays an important role in the formation of ozone in the atmosphere and it is also a precursor to fine particulate matter. It belongs to a group of substances called nitrogen oxides (NO_X).[15] Nitrogen oxides are emitted into the atmosphere from high-temperature combustion processes such as vehicle engines, power plants and industrial processes. The main sources of nitrogen oxides in Canada are transportation, the oil and gas industry and the use of fossil fuels for electricity generation and heating. Exposure to NO_2 can result in adverse health effects; it can irritate the lungs, decrease lung function and increase susceptibility to allergens for people with asthma. Long-term exposure to NO_2 may contribute to allergies and the development of asthma. It also contributes to acid rain and eutrophication of environmental ecosystems.

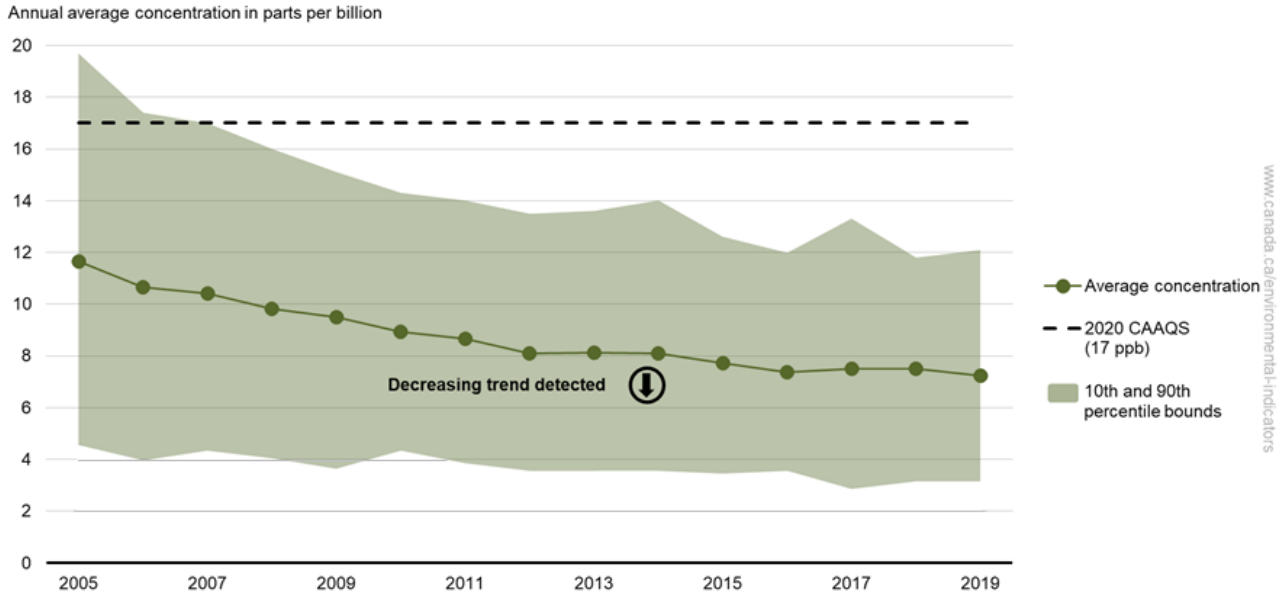
National average nitrogen dioxide concentrations[16, 17]

Key results

Between 2005 and 2019,

- a decreasing trend was detected in the average NO_2 concentrations
- national average concentrations remained below the 2020 standard[18] of 17 parts per billion (ppb) for all years; however, concentrations at some monitoring stations exceeded the standard from 2005 to 2007

Figure 18. National average nitrogen dioxide concentrations, Canada, 2005 to 2019



Data for Figure 18

Note: The national average NO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 119 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The

[15] The majority of emitted NO_X is nitrogen monoxide (NO); however, once in the atmosphere NO reacts with volatile organic compounds and ozone to form NO_2.

[16] Nitrogen dioxide concentrations are not directly measured by the monitoring equipment. These concentrations are estimated by subtracting the measured nitrogen monoxide (NO) concentration from the measured nitrogen oxides (NO_X) concentration.

[17] Average concentrations refer to the annual average of the hourly concentrations.

[18] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

shaded area shows the 10th and 90th percentile bounds of average NO_2 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the national average NO_2 concentration was 7.2 ppb, which was 4% (0.3 ppb) lower than in 2018. Between 2005 and 2019, a decreasing trend of 0.3 ppb per year was detected. From 2005 to 2019, national concentrations decreased by 38% (4.4 ppb). This trend is mainly attributable to 2 factors:

- the adoption of new regulations that led to the gradual introduction of new technologies and clean fuel for vehicles and the introduction of progressively more stringent emission regulations for vehicles and engines by the federal government
- lower emissions from fossil-fuel-fired (for example, coal-fired) power-generating utilities as a result of better emission control technologies and closures of some coal-fired power plants

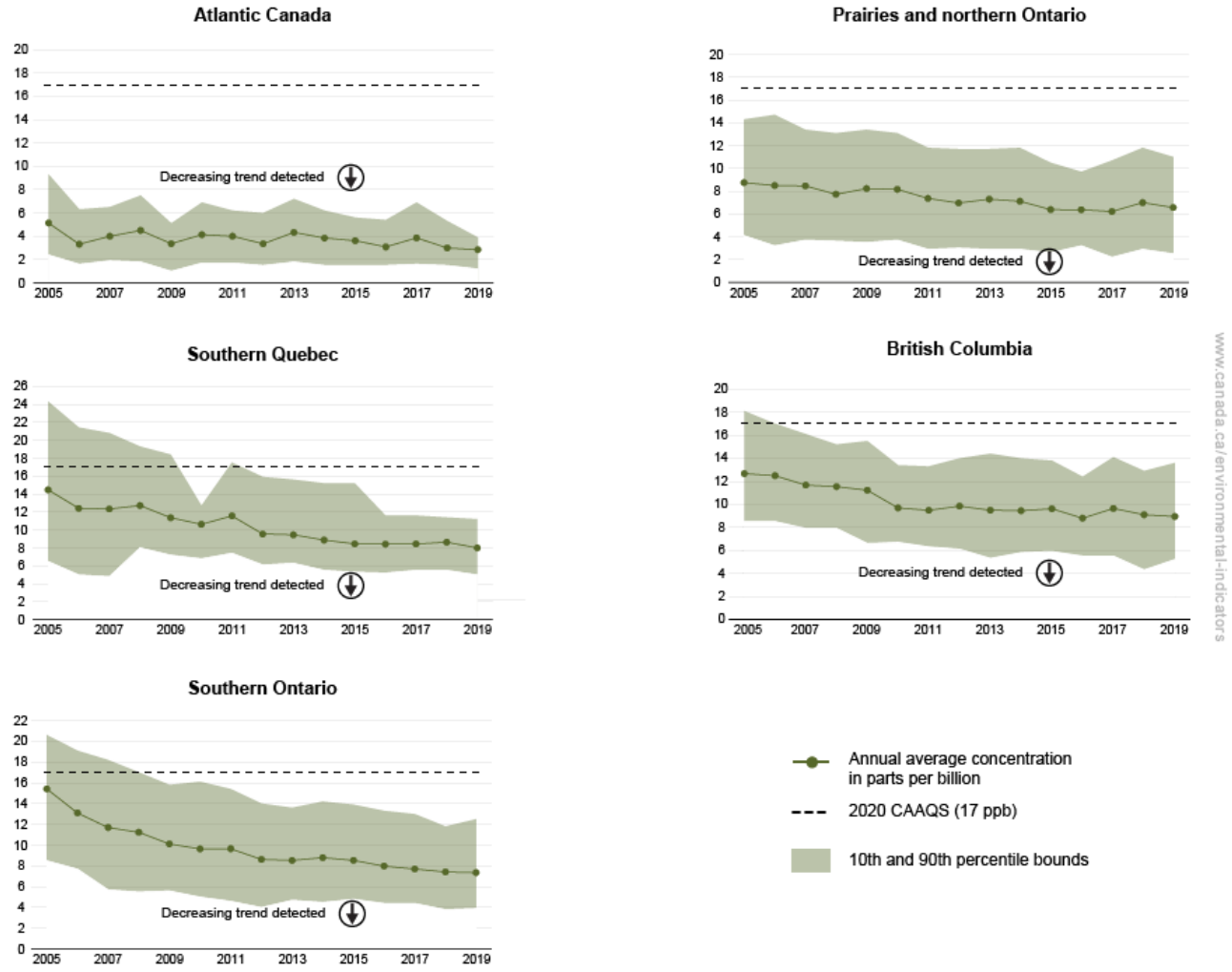
Regional average nitrogen dioxide concentrations

Key results

- Between 2005 and 2019, decreasing trends were detected for all 5 regions
- Since 2005, regional average NO_2 concentrations remained below the 2020 standard[19] of 17 ppb in all regions; however, concentrations at some monitoring stations in southern Quebec, southern Ontario and British Columbia exceeded the standard in earlier years

[19] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Figure 19. Regional average nitrogen dioxide concentrations, Canada, 2005 to 2019



Data for Figure 19

Note: The regional average NO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 7 monitoring stations in Atlantic Canada, 14 in southern Quebec, 30 in southern Ontario, 37 in the Prairies and northern Ontario region and 29 in British Columbia. There were not enough stations to report results for the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of average NO_2 concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, British Columbia had the highest regional average NO_2 concentration, at 8.9 ppb. The southern Quebec region followed with a concentration of 8.0 ppb. The southern Ontario and Prairies and northern Ontario regions reported concentrations of 7.4 ppb and 6.6 ppb, respectively. The Atlantic Canada region had the lowest regional average concentration, at 2.9 ppb.

All 5 regions had lower or similar concentrations in 2019 than in 2018. Between 2018 and 2019, the southern Quebec region had the largest reduction in concentrations, with a decrease of 7% (0.6 ppb). The Prairies and northern Ontario and Atlantic Canada regions reported decreases of 6% and 5%, respectively. British Columbia and southern Ontario had reductions of 2% and 1%, respectively.

Between 2005 and 2019, decreasing trends were detected in each region. A decreasing trend of:

- 0.4 ppb per year was detected for the southern Ontario region
    - concentrations decreased by 52% (8.1 ppb)

- 0.4 ppb per year was detected for the southern Quebec region
    - concentrations decreased by 45% (6.5 ppb)
- 0.3 ppb per year was detected for British Columbia
    - concentrations decreased by 29% (3.7 ppb)
- 0.2 ppb per year was detected for the Prairies and northern Ontario region
    - concentrations decreased by 25% (2.2 ppb)
- 0.1 ppb per year was detected for the Atlantic Canada region
    - concentrations decreased by 44% (2.3 ppb)

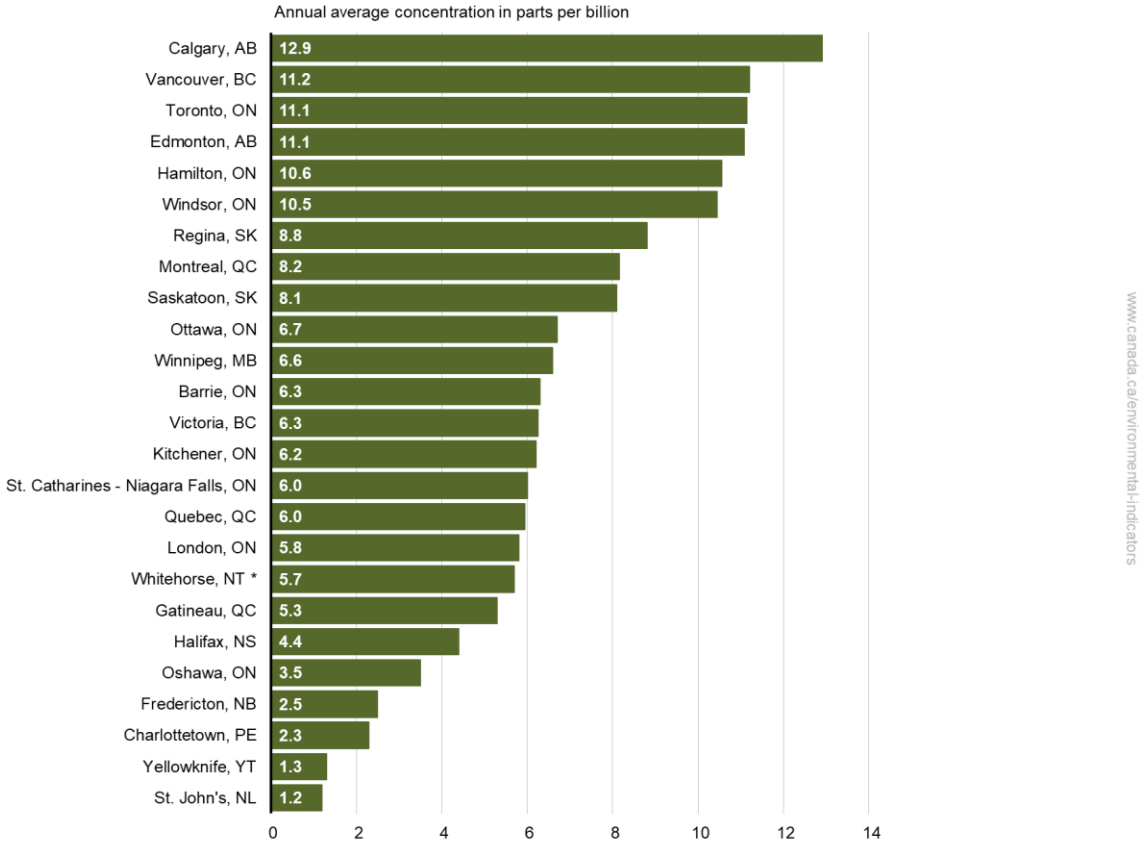
Average nitrogen dioxide concentrations in urban areas

Key results

In 2019, among the selected urban areas[20]

- Calgary, Vancouver, Toronto and Edmonton had the highest average NO_2 concentrations
- St. John's, Yellowknife and Charlottetown had the lowest concentrations

Figure 20. Average nitrogen dioxide concentrations, selected Canadian urban areas, 2019



Data for Figure 20

Note: * The concentration presented in the figure for Whitehorse was from 2018. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information. All concentrations available since 2005 for each urban areas are presented in the data table for this figure.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

[20] The 2019 concentration reported for Whitehorse was from 2018.

Average NO_2 concentrations in selected Canadian urban areas differ from one location to another and from year to year. Urban areas in proximity to important sources of NO_2, such as large road networks and highways, may explain the differences between cities.

Average nitrogen dioxide concentrations at monitoring stations

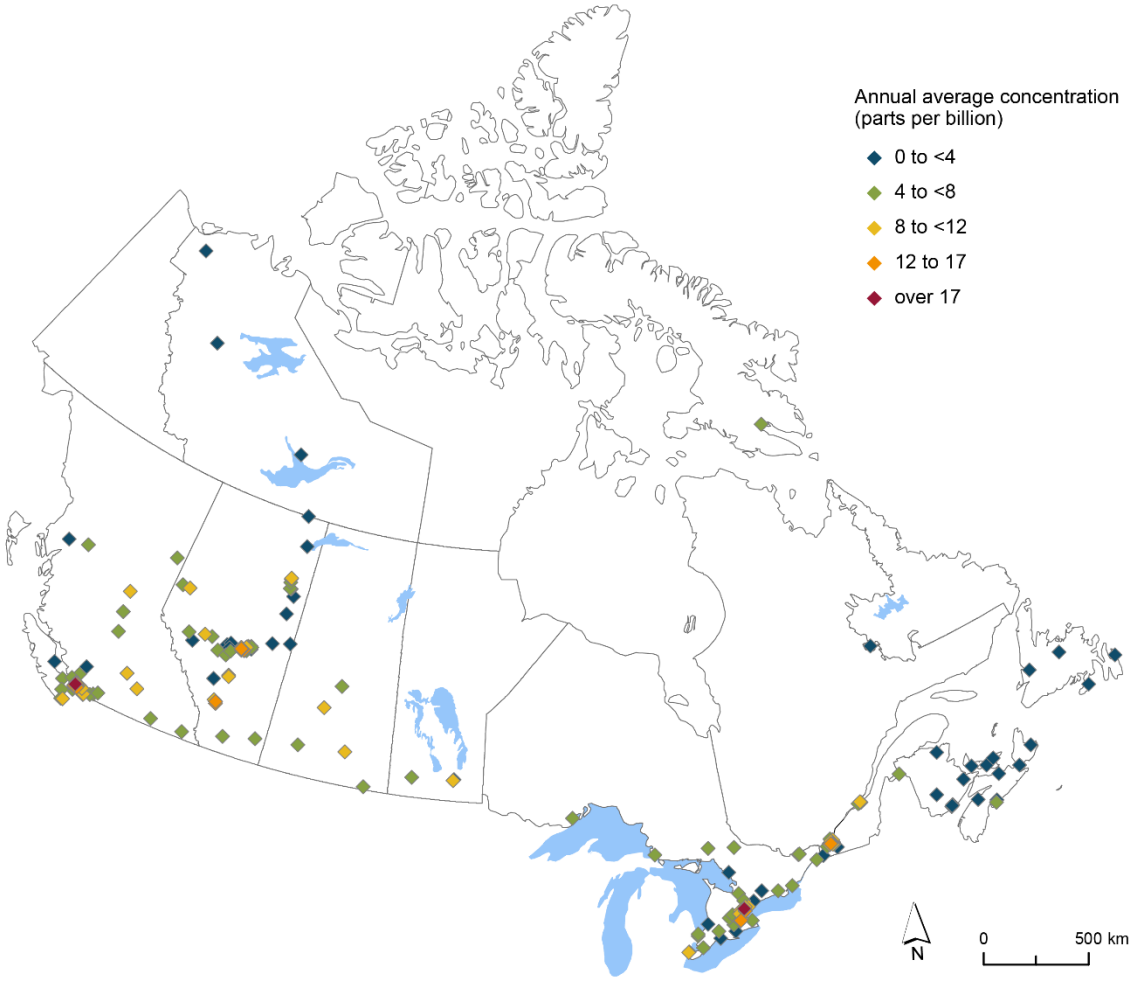
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore average NO_2 concentrations at specific monitoring stations.

In 2019, average NO_2 concentrations were recorded at 179 monitoring stations across Canada. Average NO_2 concentrations were lower in eastern and northern areas of Canada.

- 2 stations located in British Columbia and Ontario recorded concentrations above 17.0 ppb (17.9 ppb and 18.5 ppb)
- 47 stations had concentrations below 4.0 ppb
    - 4 stations recorded concentrations below 1.0 ppb; these were located in Newfoundland and Labrador, Prince Edward Island (2 stations) and Nova Scotia

Figure 21. Average nitrogen dioxide concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

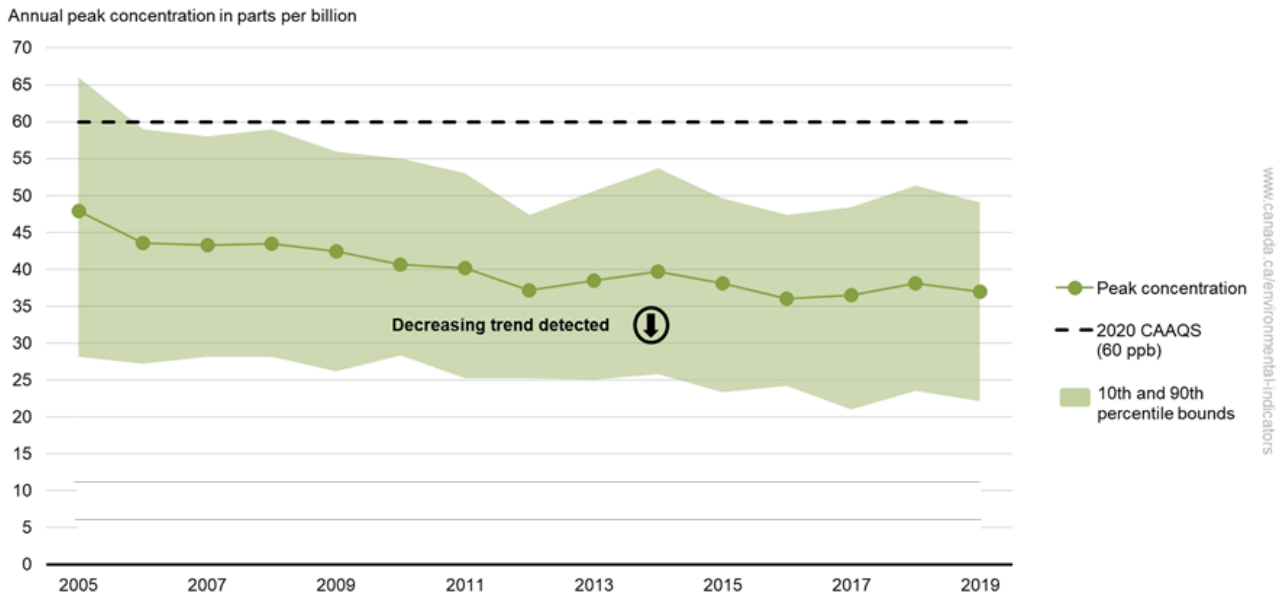
National peak nitrogen dioxide concentrations[21]

Key results

Between 2005 and 2019,

- a decreasing trend was detected in the peak NO_2 concentrations
- national peak concentrations remained below the 2020 standard[22] of 60 ppb for all years; however, concentrations at some monitoring stations exceeded the standard in 2005

Figure 22. National peak nitrogen dioxide concentrations, Canada, 2005 to 2019



Data for Figure 22

Note: The national peak NO_2 concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 120 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak NO_2 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the national peak NO_2 concentration was 37.0 ppb, which was 3% lower than in 2018. Between 2005 and 2019, a decreasing trend of 0.7 ppb per year was detected. From 2005 to 2019, national concentrations decreased by 23% (10.9 ppb). This trend is mainly attributable to 2 factors:

- the adoption of new regulations that led to the gradual introduction of new technologies and clean fuel for vehicles and the introduction of progressively more stringent emission regulations for vehicles and engines by the federal government
- lower emissions from fossil-fuel-fired (for example, coal-fired) power-generating utilities as a result of better emission control technologies and closures of some coal-fired power plants

[21] Peak concentrations refers to the annual 98th percentile of the daily maximum 1-hour average concentrations.

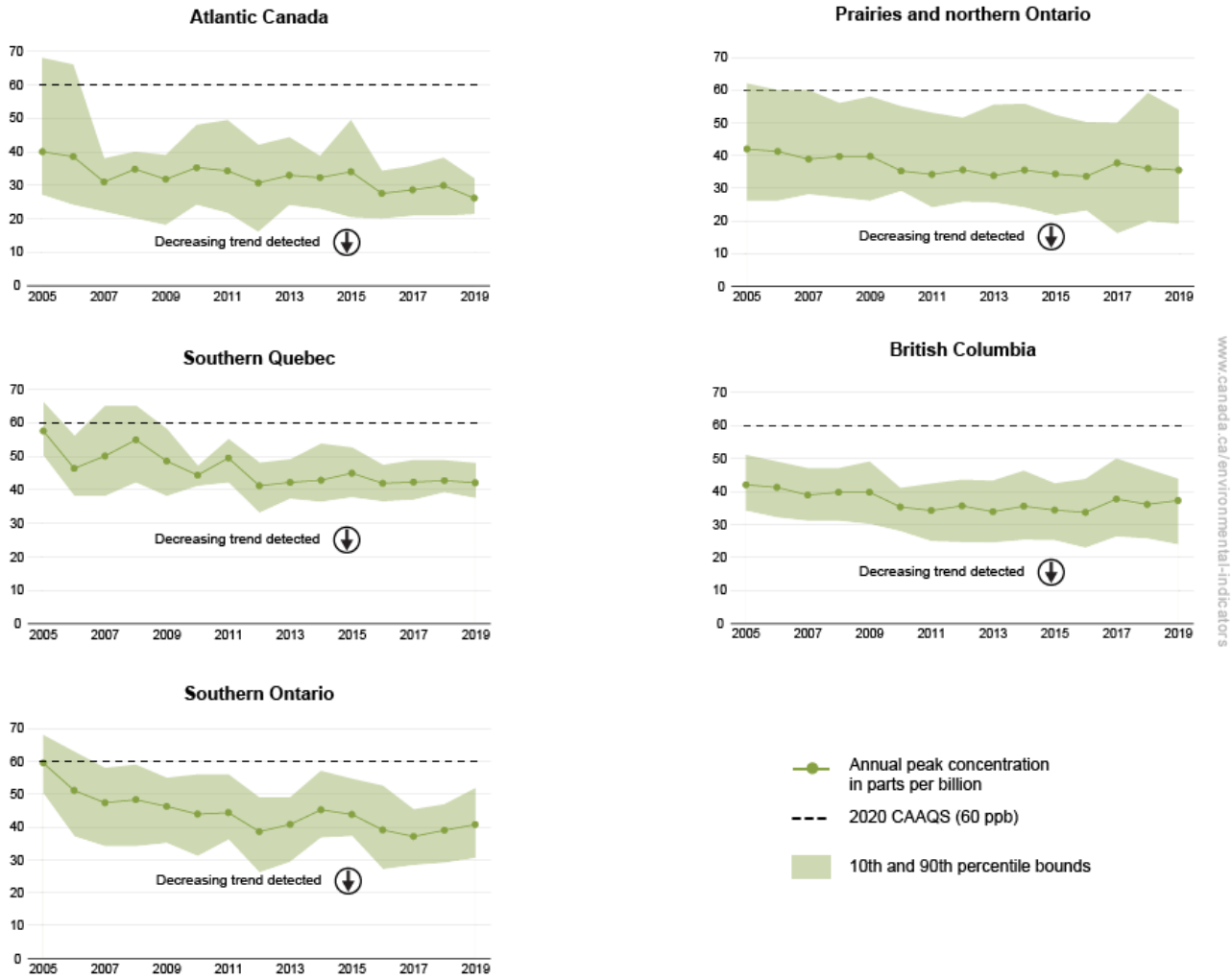
[22] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Regional peak nitrogen dioxide concentrations

Key results

- Between 2005 and 2019, decreasing trends were detected for all 5 regions
- Since 2005, regional peak NO_2 concentrations remained below the 2020 standard[23] of 60 ppb in all regions; however, with the exception of British Columbia, concentrations at some monitoring stations exceeded the standard in earlier years

Figure 23. Regional peak nitrogen dioxide concentrations, Canada, 2005 to 2019



Data for Figure 23

Note: The regional peak NO_2 concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 8 monitoring stations in Atlantic Canada, 14 in southern Quebec, 30 in southern Ontario, 37 in the Prairies and northern Ontario region and 29 in British Columbia. There were not enough stations to report results for the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak NO_2 concentrations across monitoring stations in each region. For more information, consult the Air quality indicator

[23] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, southern Quebec had the highest regional peak NO_2 concentration, at 42.1 ppb. The southern Ontario region followed with a concentration of 40.8 ppb. The Prairies and northern Ontario region and British Columbia reported concentrations of 36.2 ppb and 35.5 ppb, respectively. The Atlantic Canada region had the lowest regional peak concentration, at 26.2 ppb.

With the exception of southern Ontario, all regions had lower concentrations in 2019 than in 2018. Between 2018 and 2019, the Atlantic Canada region had the largest reduction in concentrations, with a decrease of 13% (3.8 ppb). The Prairies and northern Ontario and southern Quebec regions reported decreases of 9% (3.5 ppb) and 2% (0.7 ppb), respectively. British Columbia reported a decrease of 1% (0.5 ppb). Between 2018 and 2019, southern Ontario reported an increase of 4% (1.7 ppb).

Between 2005 and 2019, decreasing trends were detected in each region. A decreasing trend of:

- 1.0 ppb per year was detected for southern Ontario
    - concentrations in southern Ontario decreased by 31% (18.7 ppb)
- 0.7 ppb per year was detected the Atlantic Canada region
    - concentrations decreased by 35% (13.8 ppb)
- 0.7 ppb per year was detected for the southern Quebec region
    - concentrations decreased by 27% (15.5 ppb)
- 0.5 ppb per year was detected for the Prairies and northern Ontario region
    - concentrations decreased by 15% (6.6 ppb)
- 0.5 ppb per year was detected for British Columbia
    - concentrations decreased by 15% (6.5 ppb)

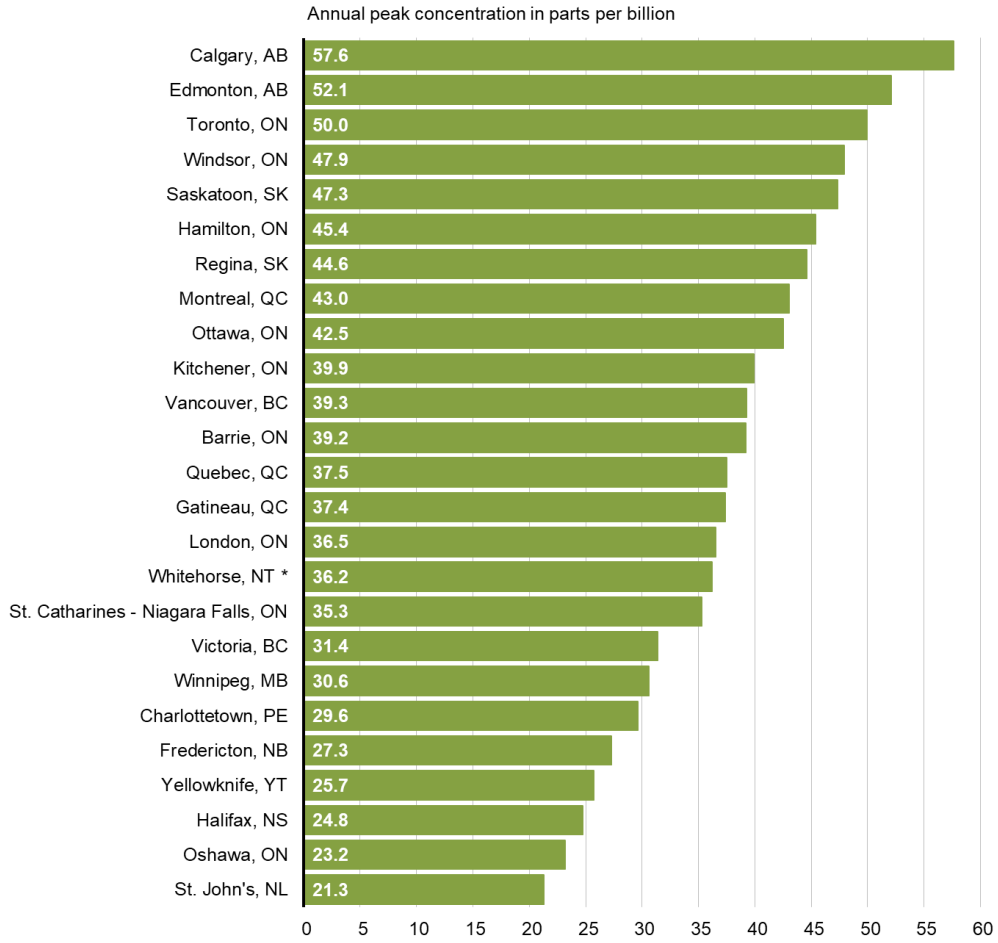
Peak nitrogen dioxide concentrations in urban areas

Key results

In 2019, among the selected urban areas[24]

- Calgary, Edmonton and Toronto had the highest peak NO_2 concentrations
- St. John's, Oshawa and Halifax had the lowest concentrations

Figure 24. Peak nitrogen dioxide concentrations, selected Canadian urban areas, 2019



Data for Figure 24

Note: * The concentration presented in the figure for Whitehorse was from 2018. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information. All concentrations available since 2005 for each urban areas are presented in the data table for this figure.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Peak NO_2 concentrations in selected Canadian urban areas differs from one location to another and from year to year. Urban areas in proximity to important sources of NO_2, such as large road network and highways, may explain the differences between cities.

[24] The 2019 concentration reported for Whitehorse was from 2018.

Peak nitrogen dioxide concentrations at monitoring stations

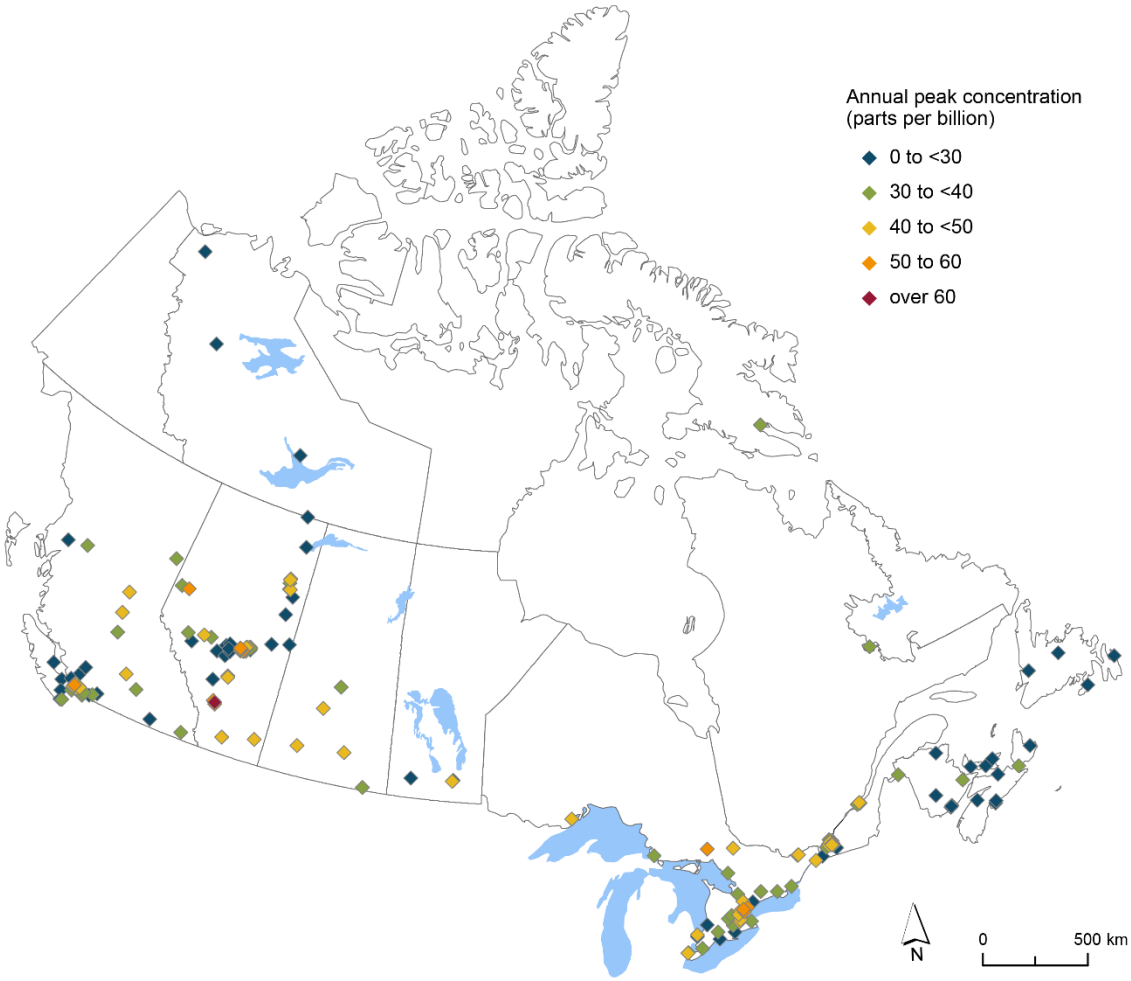
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore peak NO_2 concentrations at specific monitoring stations.

In 2019, peak NO_2 concentrations were recorded at 178 monitoring stations across Canada. Of these stations:

- 1 station in Alberta recorded a concentration above 60.0 ppb (62.7 ppb)
- 58 stations had concentrations below 30.0 ppb
    - 5 stations had concentrations below 10.0 ppb; these were located in Newfoundland and Labrador, Prince Edward Island (2 stations), Nova Scotia and Alberta

Figure 25. Peak nitrogen dioxide concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Sulphur dioxide

Sulphur dioxide (SO_2) is emitted when a fuel or raw material containing sulphur is burned or used in industrial processes such as metal ore smelting. The main sources of sulphur oxide emissions in Canada are the combustion of fuel for electricity generation and heating, processes in the non-ferrous smelting and refining industry, and the oil and gas industry. Sulphur dioxide emissions contribute to acid deposition and are a major precursor to fine particulate matter. High concentrations of SO_2 can adversely affect the respiratory systems of humans and animals. It can irritate the lungs, reduce lung function and increase susceptibility to allergens in people with asthma. Sulphur dioxide can also damage vegetation and materials.

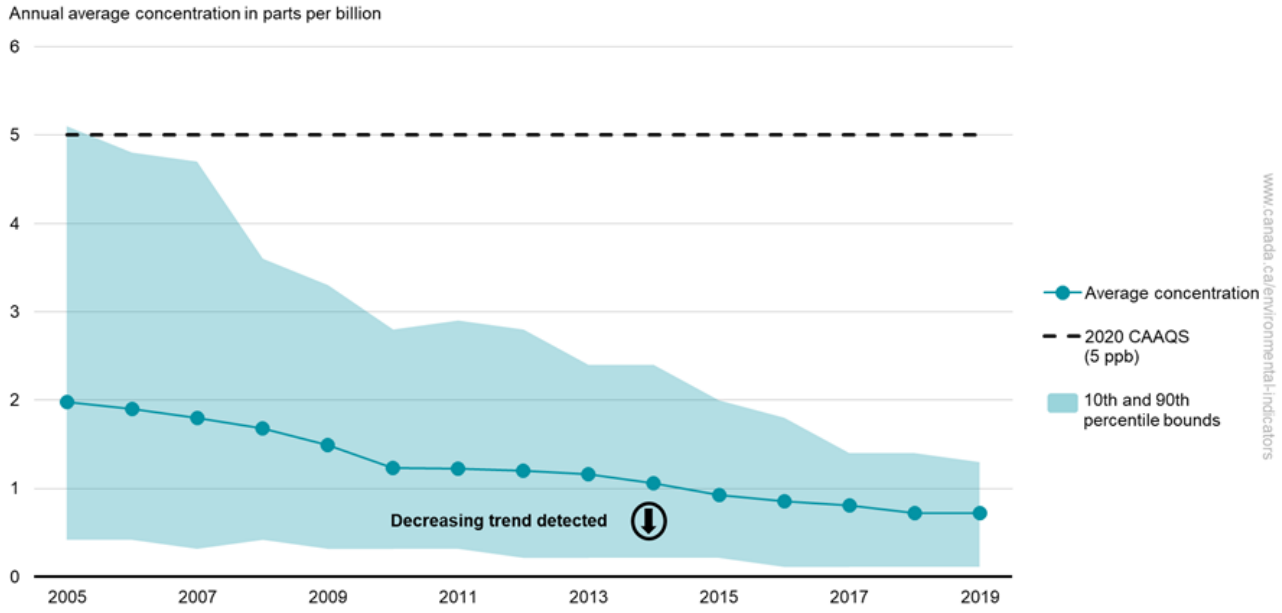
National average sulphur dioxide concentrations[25]

Key results

Between 2005 and 2019,

- a decreasing trend was detected in the average SO_2 concentrations
- national average concentrations remained below the 2020 standard[26] of 5 parts per billion (ppb) for all years; however, concentrations at some monitoring stations were above the standard in 2005

Figure 26. National average sulphur dioxide concentrations, Canada, 2005 to 2019



Data for Figure 26

Note: The national average SO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 80 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of average SO_2 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

[25] Average concentrations refer to the annual average of the hourly concentrations.

[26] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

In 2019, the national average SO_2 concentration was 0.7 parts per billion (ppb), which was 1% lower than in 2018. Between 2005 and 2019, a decreasing trend of 0.1 ppb per year was detected. From 2005 to 2019, national concentrations decreased by 64% (1.3 ppb). This trend is mainly attributable to reductions in sulphur oxide (SO_X) emissions in Canada resulting from technological upgrades and closures of non-ferrous metal smelters (including aluminium smelters) and pulp and paper facilities, the phase-out of coal-fired electricity, better emission control technologies within the oil and gas sector and the implementation of federal regulations related to sulphur content in fuels.

Regional average sulphur dioxide concentrations

Key results

- Between 2005 and 2019, decreasing trends were detected for all 5 regions
- Since 2005, regional average SO_2 concentrations remained below the 2020 standard[27] of 5 ppb in all regions; however, with the exception of British Columbia and the Prairies and northern Ontario regions, concentrations at some monitoring stations exceeded the standard

[27] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Figure 27. Regional average sulphur dioxide concentrations, Canada, 2005 to 2019

Data for Figure 27

Note: The regional average SO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 4 monitoring stations in Atlantic Canada, 9 in southern Quebec, 10 in southern Ontario, 32 in the Prairies and northern Ontario region and 23 in British Columbia. There were not enough stations to report results for the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of average SO_2 concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, southern Quebec and southern Ontario had the highest regional average SO_2 concentration, each reporting 1.2 ppb. Atlantic Canada and British Columbia followed with concentrations of 0.9 ppb and 0.7 ppb, respectively. The Prairies and northern Ontario region had the lowest regional average concentration, at 0.5 ppb.

Atlantic Canada and southern Ontario had lower concentrations in 2019 than in 2018. Between 2018 and 2019, the Atlantic Canada region had the largest reduction in concentrations, with a decrease of 17% (0.2 ppb), while the southern Quebec and southern Ontario regions reported 16% (0.2 ppb) and 13% (0.2 ppb) reductions, repectively. British Columbia reported a 10% (0.1 ppb) increase over the same period. The average SO_2 concentration in the Prairies and northern Ontario region was relatively unchanged between 2018 and 2019.

Between 2005 and 2019, decreasing trends were detected in each region. A decreasing trend of:

- 0.2 ppb per year was detected for southern Ontario
    - concentrations decreased by 70% (2.7 ppb)

- 0.1 ppb per year was detected for the remaining regions (Atlantic Canada, southern Quebec, the Prairies and northern Ontario region and British Columbia)
    - concentrations in Atlantic Canada and southern Quebec decreased by 66% (1.7 ppb) and 71% (2.9 ppb), respectively
    - concentrations in the Prairies and northern Ontario region decreased by 59% (0.7 ppb)
    - concentrations in British Columbia decreased by 48% (0.7 ppb)

Average sulphur dioxide concentrations at monitoring stations

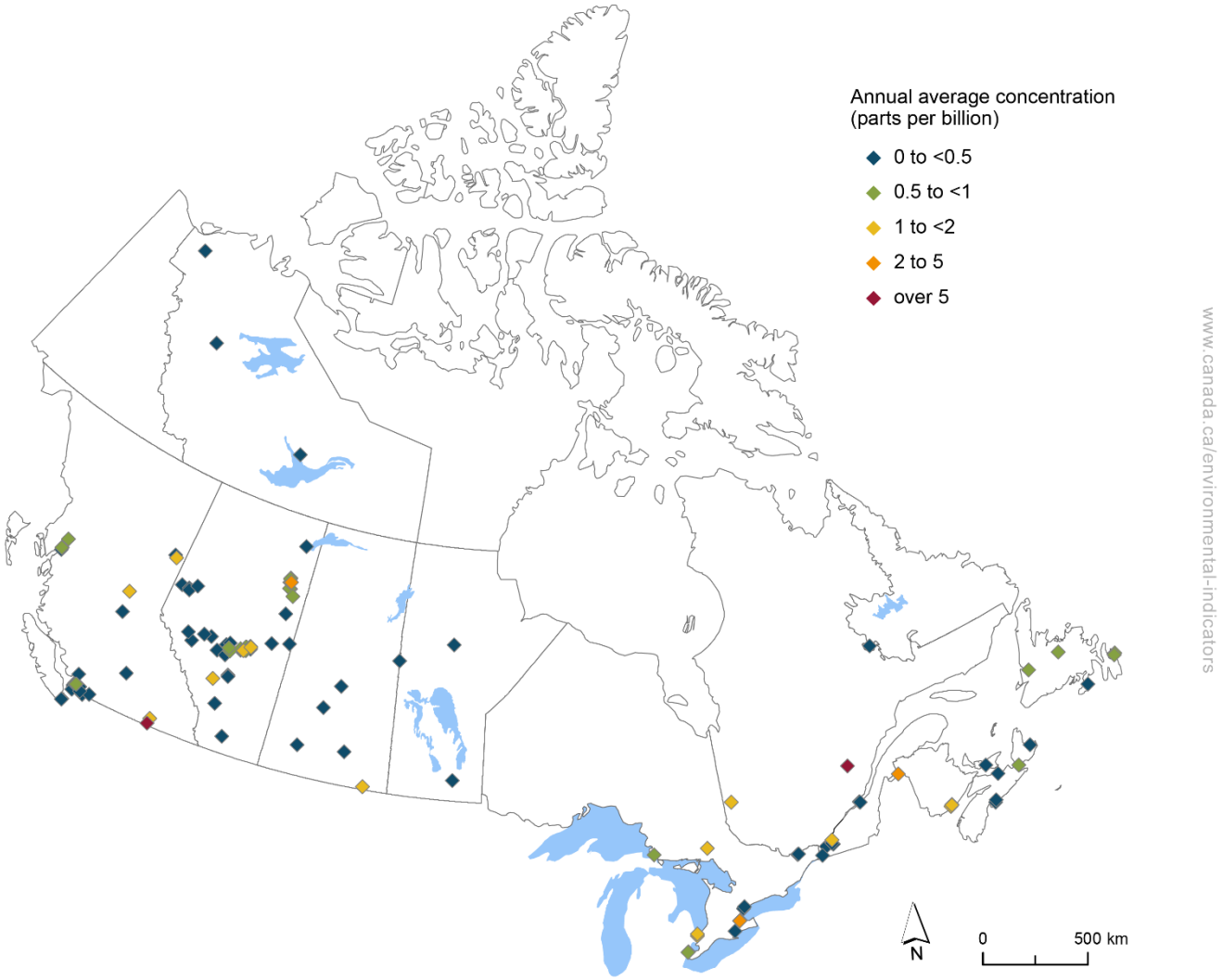
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore average SO_2 concentrations at specific monitoring stations.

In 2019, average SO_2 concentrations were recorded at 124 monitoring stations across Canada. Of these stations:

- 2 stations recorded concentrations above 5.0 ppb
    - 1 station in Quebec and 1 in British Columbia reported concentrations of 5.5 ppb and 7.5 ppb, respectively
- 79 stations had concentrations below 0.5 ppb
    - 13 stations recorded concentrations of 0.1 ppb. Of these stations, 1 was located in each Newfoundland and Labrador, Quebec, Manitoba and Saskatchewan, 5 were located in Alberta, 3 were in British Columbia and 1 station was located in the Northwest Territories

Figure 28. Average sulphur dioxide concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

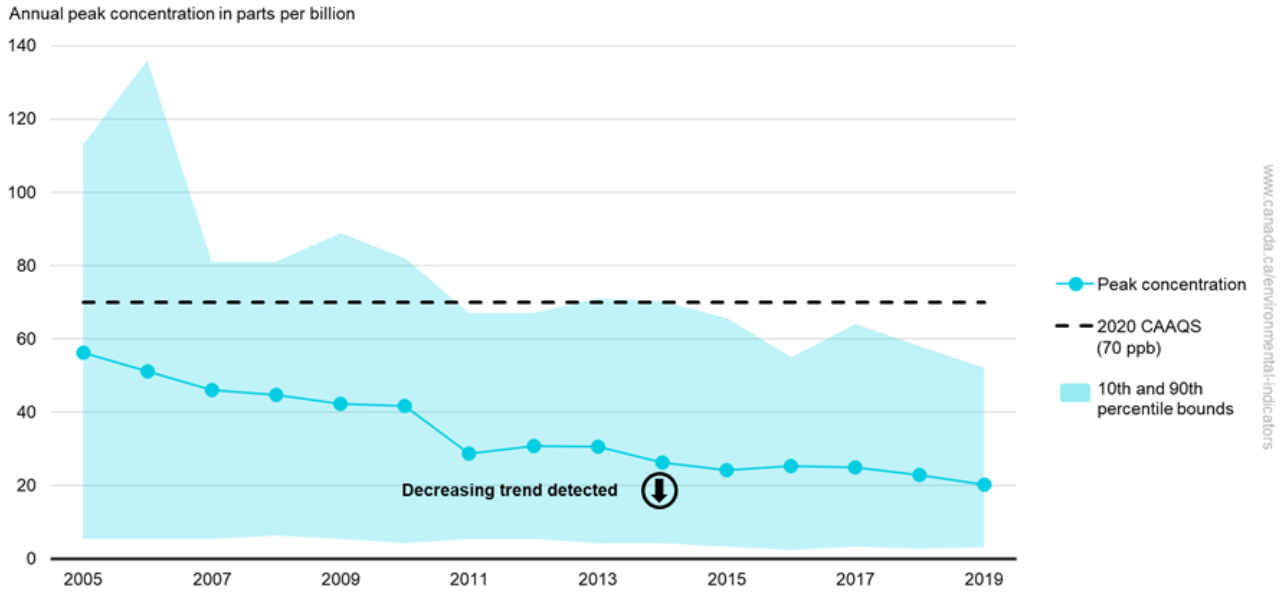
National peak sulphur dioxide concentrations[28]

Key results

Between 2005 and 2019,

- a decreasing trend was detected in the peak SO_2 concentrations
- national peak concentrations remained below the 2020 standard[29] of 70 ppb for all years; however, concentrations at some monitoring stations were above the standard in most years

Figure 29. National peak sulphur dioxide concentrations, Canada, 2005 to 2019



Data for Figure 29

Note: The national peak SO_2 concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 81 monitoring stations across Canada. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak SO_2 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the national peak SO_2 concentration was 20.3 ppb, which was 11% lower than in 2018. Between 2005 and 2019, a decreasing trend of 2.4 ppb per year was detected. From 2005 to 2019, national concentrations decreased by 64% (36.0 ppb). This trend is mainly attributable to reductions in sulphur oxide (SO_X) emissions in Canada and the United States resulting from technological upgrades and closures of non-ferrous metal smelters, the phase-out of coal-fired electricity, better emission control technologies within the oil and gas sector and the implementation of federal regulations related to sulphur content in fuels.

[28] Peak concentrations refers to the annual 99th percentile of the daily maximum 1-hour average concentrations.

[29] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

Regional peak sulphur dioxide concentrations

Key results

- Between 2005 and 2019, decreasing trends were detected for all 5 regions
- Since 2007, regional peak SO_2 concentrations remained below the 2020 standard[30] of 70 ppb in all regions; however, concentrations Atlantic Canada, southern Quebec and southern Ontario exceeded the standards in 2005 and 2006. Concentrations at some monitoring stations exceeded the standard in all regions

Figure 30. Regional peak sulphur dioxide concentrations, Canada, 2005 to 2019

Data for Figure 30

Note: The regional peak SO_2 concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 5 monitoring stations in Atlantic Canada, 9 in southern Quebec, 10 in southern Ontario, 32 in the Prairies and northern Ontario region and 23 in British Columbia. There were not enough stations to report results for the northern territories region. The horizontal dashed line represents the 2020 Canadian Ambient Air Quality Standard (CAAQS). The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the

[30] The comparison to the Canadian Ambient Air Quality Standard (CAAQS) is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year averageWhile the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.

standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. The shaded area shows the 10th and 90th percentile bounds of peak SO_2 concentrations across monitoring stations in Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, southern Quebec had the highest regional peak SO_2 concentration, at 32.7 ppb. Southern Ontario, Atlantic Canada and the Prairies and northern Ontario region followed with concentrations of 32.4 ppb, 20.8 ppb and 17.5 ppb, respectively. British Columbia had the lowest regional peak concentration, at 16.3 ppb.

With the exception of southern Quebec, all regions had lower concentrations in 2019 than in 2018. Between 2018 and 2019, the Atlantic Canada region had the largest reduction in concentrations, with a decrease of 35% (11.0 ppb). Southern Ontario, British Columbia and the Prairies and northern Ontario region reported decreases of 12% (4.4 ppb), 17% (3.4 ppb) and 7% (1.2 ppb), respectively over the same period. Southern Quebec reported a 12% (3.4 ppb) increase in concentrations in from 2018 to 2019.

Between 2005 and 2019, decreasing trends were detected in each region. A decreasing trend of:

- 3.7 ppb per year was detected for Atlantic Canada
    - concentrations decreased by 74% (58.9 ppb)
- 2.8 ppb per year was detected for southern Ontario
    - concentrations decreased by 61% (50.4 ppb)
- 2.6 ppb was detected for both the southern Quebec and Prairies and northern Ontario regions
    - concentrations in the southern Quebec and the Prairies and northern Ontario regions decreased by 56% (42.1 ppb) and 69% (39.8 ppb), respectively
- 1.8 ppb was detected for British Columbia
    - concentrations decreased by 56% (20.8 ppb)

Peak sulphur dioxide concentrations at monitoring stations

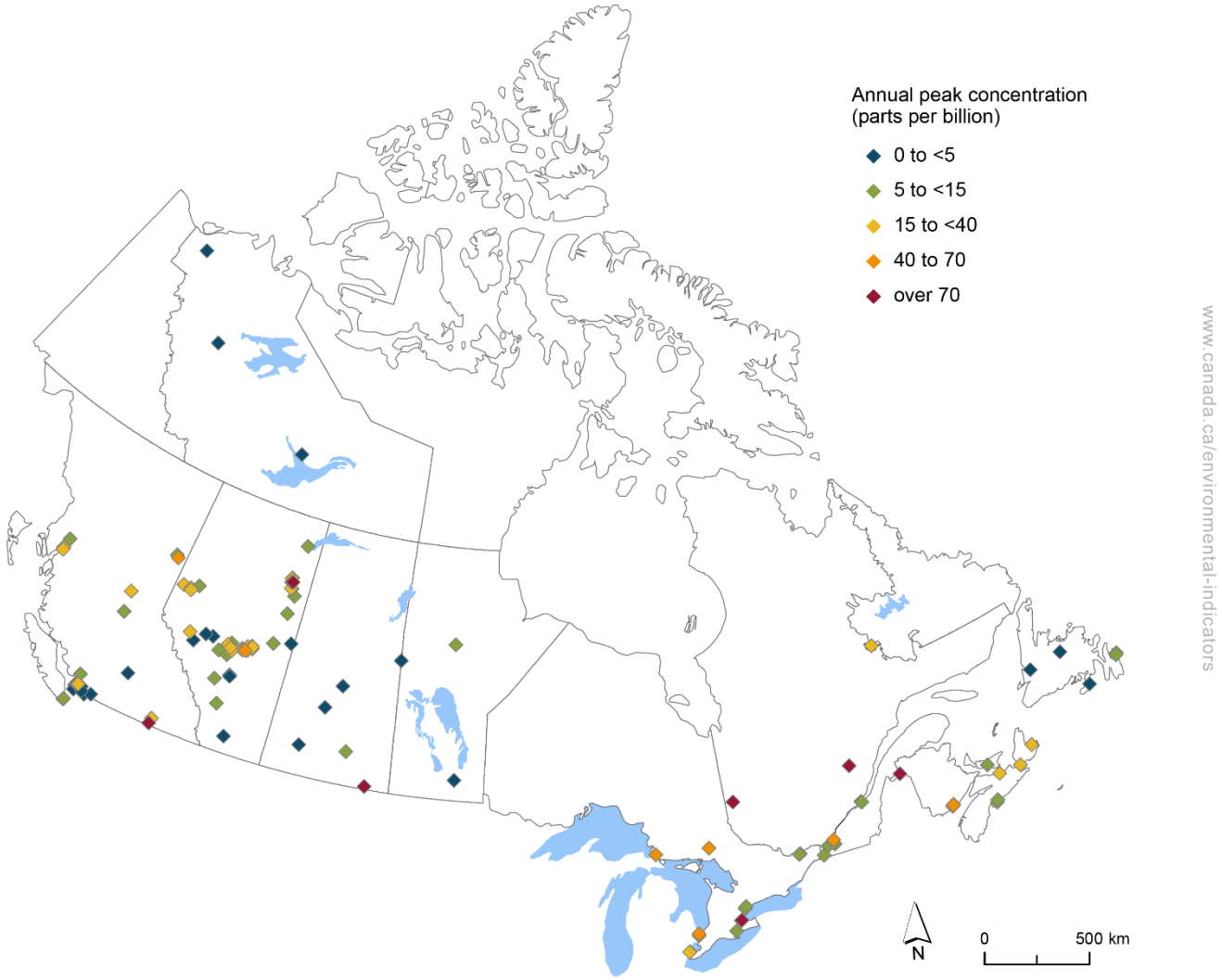
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore peak SO_2 concentrations at specific monitoring stations.

In 2019, peak SO_2 concentrations were recorded at 124 monitoring stations across Canada.

- 7 stations recorded concentrations above 70 ppb, ranging from 82.4 ppb to 147.0 ppb. Of these stations, 1 was located in New Brunswick, 2 were in Quebec, 1 each in Ontario, Saskatchewan, Alberta and British Columbia
- 35 stations had concentrations below 5 ppb
    - 4 stations recorded concentrations of less than 1.0 ppb. Of these, a single station was located in both Newfoundland and Labrador and Saskatchewan and 2 were located in the Northwest Territories

Figure 31. Peak sulfur dioxide concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Volatile organic compounds

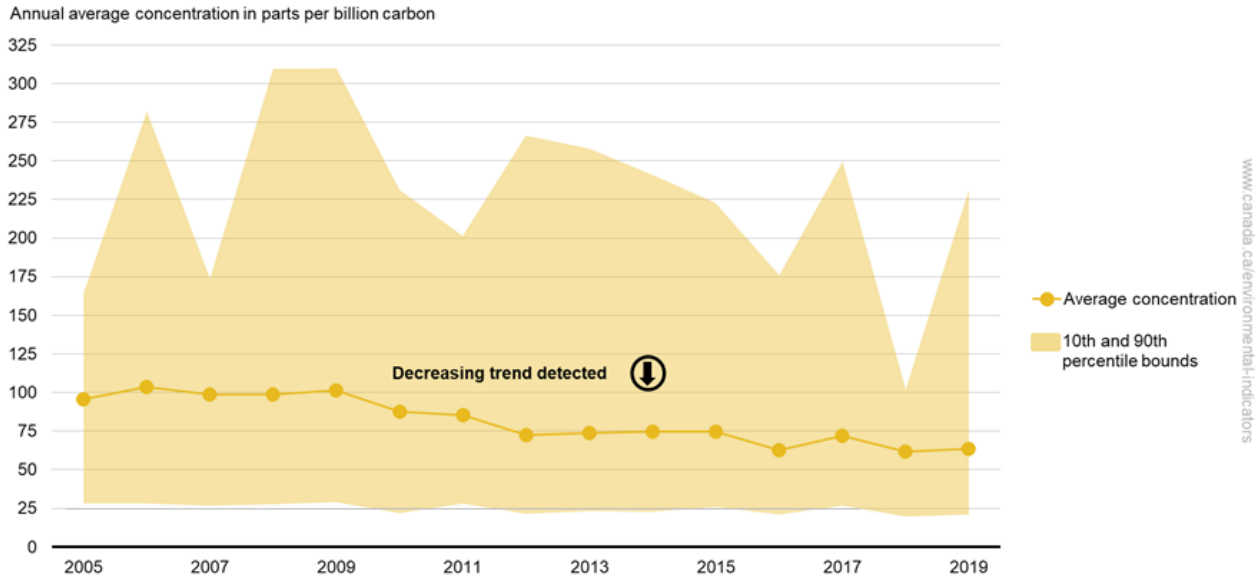
Volatile organic compounds (VOCs) are carbon-containing gases and vapours that are found in many common products such as gasoline and solvents.[31] Volatile organic compounds are emitted from the oil and gas industry, solvent usage and transportation. Some VOCs can cause cancer and other serious health problems. Short-term exposure to high-levels of some VOCs can result in fatigue, nausea, dizziness, headaches, breathing problems and irritation of the eyes, nose and throat. Volatile organic compounds contribute to the formation of fine particulate matter ($PM_{2.5}$) and ozone (O_3), which are the main components of smog.

National average volatile organic compound concentrations[32]

Key results

Between 2005 and 2019, a decreasing trend was detected in the national average VOC concentrations

Figure 32. National average volatile organic compound concentrations, Canada, 2005 to 2019



Data for Figure 32

Note: The national average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) recorded at 30 monitoring stations across Canada. The shaded area shows the 10th and 90th percentile bounds of average VOC concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the national average VOC concentration was 63.6 parts per billion carbon (ppbC), which was 3% (1.9 ppbC) higher than in 2018. Between 2005 and 2019, a decreasing trend of 3.2 ppbC per year was detected. Over this period, national concentrations decreased by 33% (31.9 ppbC). This is consistent with the reduction in VOC emissions from cars and trucks, which is attributable to the introduction of new technologies, cleaner fuels and more stringent emissions standards and from reduction measures related to the production and use of paints, solvents and cleaners.

[31] Volatile organic compounds do not include carbon dioxide, carbon monoxide, methane and chlorofluorocarbon compounds.

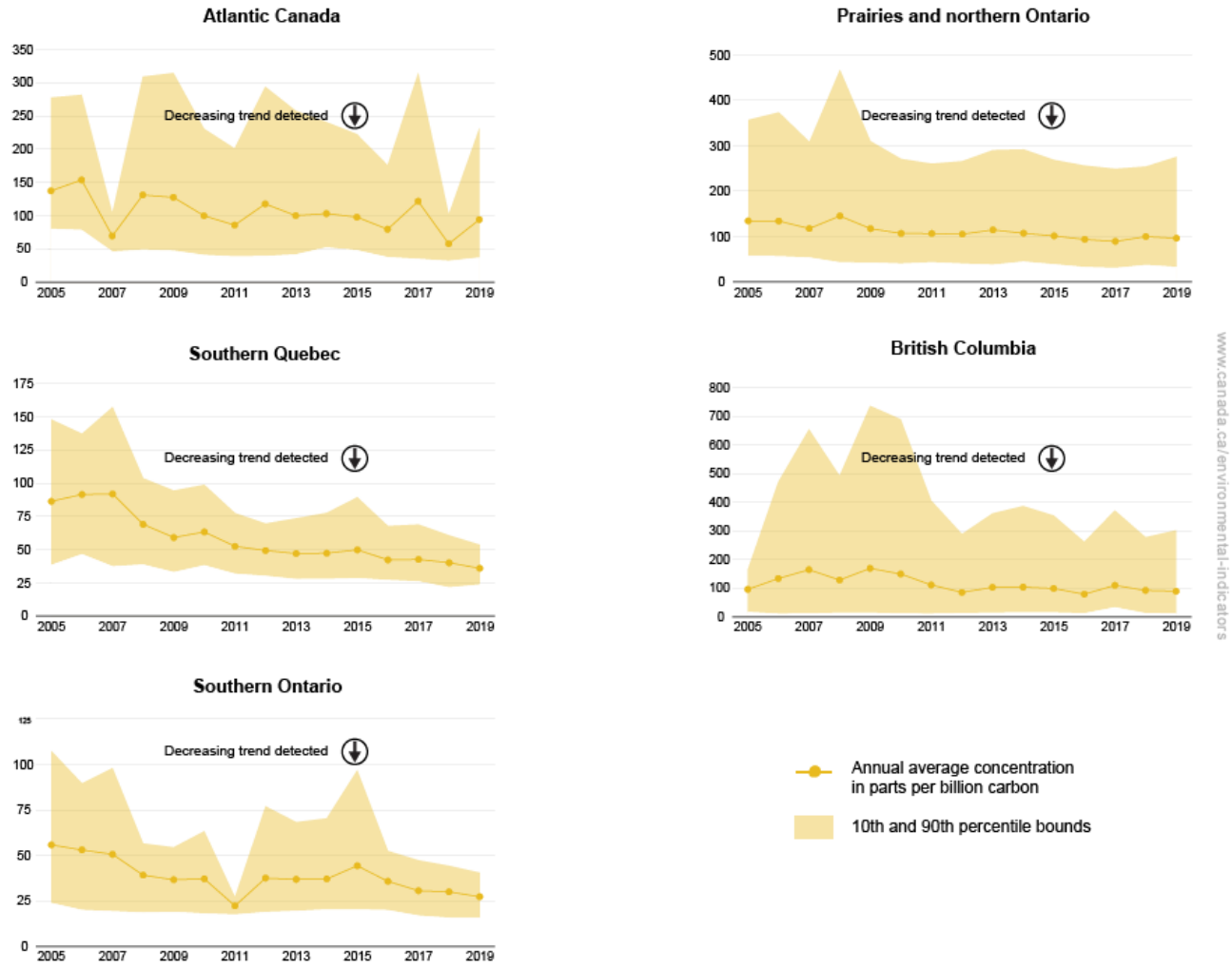
[32] Average concentrations refer to the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations).

Regional average volatile organic compound concentrations

Key results

- Between 2005 and 2019, decreasing trends were detected for all 5 regions
- Average VOC concentrations varied by region and by monitoring station within each region

Figure 33. Regional average volatile organic compound concentrations, Canada, 2005 to 2019



Data for Figure 33

Note: The average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) recorded at 4 monitoring stations in Atlantic Canada, 5 in southern Quebec, 9 in southern Ontario, 5 in the Prairies and northern Ontario region and 7 in British Columbia. There were not enough stations to report results for the northern territories region. The shaded area shows the 10th and 90th percentile bounds of average VOC concentrations across monitoring stations in each region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

In 2019, the Prairies and northern Ontario region had the highest regional average VOC concentration, at 96.3 ppbC. Atlantic Canada, British Columbia and southern Quebec followed with concentrations of 94.1 ppbC, 89.3 ppbC and 36.0 ppbC, respectively. The southern Ontario region had the lowest regional average concentration, at 27.3 ppbC.

With the exception of Atlantic Canada, all other regions had lower concentrations in 2019 than in 2018. Between 2018 and 2019, the southern Quebec region had the largest reduction in concentrations, with a decrease of 10% (4.2 ppbC). Southern Ontario, the Prairies and northern Ontario region and British Columbia reported decreases

of 9% (2.7 ppbC), 4% (3.7 ppbC) and 3% (2.7 ppbC), respectively over the same period. The Atlantic Canada region reported a 63% (36.4 ppbC) increase in concentrations from 2018 to 2019.

Between 2005 and 2019, decreasing trends were detected in each region. A decreasing trend of:

- 3.5 ppbC per year was detected for the Atlantic Canada region and British Columbia
    - concentrations for the Atlantic Canada region and British Columbia decreased by 31% (43.2 ppbC) and 7% (6.7 ppbC), respectively
- 3.3 ppbC per year was detected for the southern Quebec region
    - concentrations decreased by 58% (50.4 ppbC)
- 2.9 ppbC per year was detected for the Prairies and northern Ontario region
    - concentrations decreased by 28% (38.1 ppbC)
- 1.6 ppbC was detected for the southern Ontario region
    - concentrations decreased by 51% (28.5 ppbC)

Average volatile organic compounds concentrations at monitoring stations

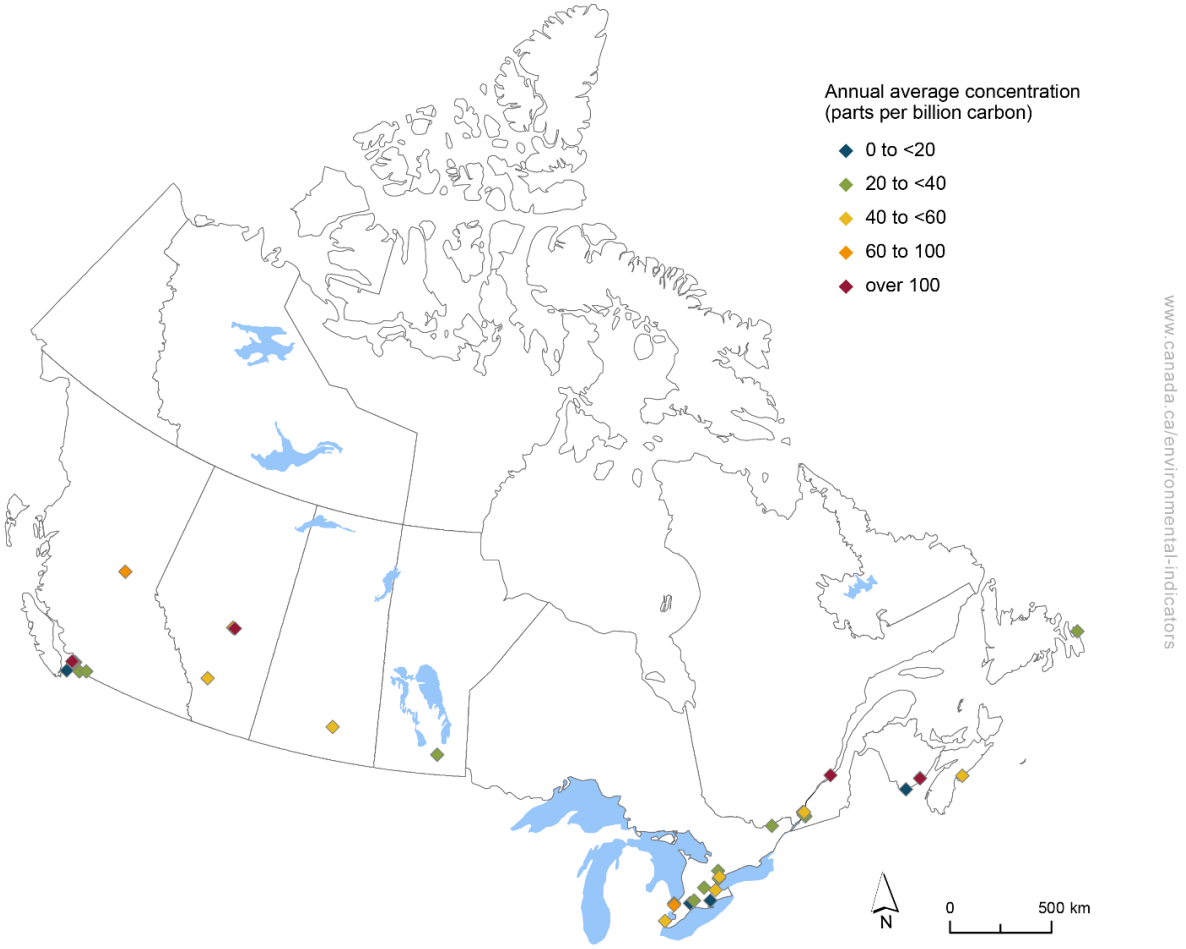
The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada.

The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows you to explore average VOC concentrations at specific monitoring stations.

In 2019, average VOC concentrations were recorded at 37 monitoring stations across Canada.

- 5 stations recorded concentrations above 100 ppbC, ranging from 112.3 ppbC to 301.8 ppbC. Of these stations, 1 station was located in New Brunswick, Quebec and Alberta and 2 stations were in British Columbia
- 4 stations had concentrations below 20.0 ppbC. Of these, 1 station was located in New Brunswick, 2 were in Ontario and 1 was located in British Columbia

Figure 34. Average volatile organic compounds concentrations by monitoring station, Canada, 2019



Navigate data using the interactive map

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

About the indicators

What the indicators measure

The Air quality indicators track ambient concentrations of fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and volatile organic compounds (VOCs) at the national, regional and urban area levels and at local monitoring stations. The national and regional indicators are presented with their corresponding 2020 Canadian Ambient Air Quality Standards (CAAQS, the standards). The comparison to the standards are for illustrative purposes only and should not be used for evaluating overall air quality in Canada.

Why these indicators are important

Canadians are exposed to air pollutants on a daily basis and this exposure can result in adverse health effects. Exposure to some air pollutants, even at low levels, has been linked to increased heart and respiratory problems, leading to increased hospitalization, emergency room visits and premature death. The Government of Canada estimates that each year 42 premature deaths per 100 000 Canadians can be linked to air pollution for a total of

15 300 premature deaths. The total economic valuation of the health impacts attributable to air pollution in Canada is $120 billion per year (based on 2016 currency).[33]

Ground-level O_3 and $PM_{2.5}$ are key components of smog and 2 of the most widespread air pollutants. Exposure to these pollutants, even at very low levels, has been associated with pulmonary, cardiovascular and respiratory health effects. Exposure to O_3 can cause throat irritation, coughing, shortness of breath and reduced lung function and can also aggravate existing conditions, such as asthma or other chronic lung diseases. Exposure to $PM_{2.5}$ can lead to respiratory and cardiovascular effects, such as asthma attacks, chronic bronchitis, heart attacks as well as lung cancer.

Exposure to SO_2 and NO_2 can irritate the lungs, reduce lung function and increase susceptibility to allergens in people with asthma. Long-term exposure to NO_2 may contribute to allergies and asthma development. Fine particulate matter ($PM_{2.5}$), O_3 and NO_2 are known to have adverse health effects occurring even at the lowest concentrations. Adverse health effects from exposure to VOCs varies greatly from little effects on health, to moderate effects such as eye, nose and throat irritations, headaches, nausea, dizziness and the worsening of asthma symptoms, to more severe effects such as damage to the liver, kidneys and central nervous system. Some VOCs meet the definition of toxic under the *Canadian Environmental Protection Act, 1999*. Over a life-time, exposure to these pollutants can increase the risk of developing cancer (PDF; 78 kB) and other serious health effects.

Beside their direct effects on health, VOCs and NO_2 contribute to the formation of O_3 and $PM_{2.5}$ and NO_2 has major impacts on acid deposition (sometimes termed "acid rain") and eutrophication. Similarly, SO_2 is also a major contributor to acid deposition. Fine particulate matter ($PM_{2.5}$) can damage vegetation and structures and contributes to haze and reduced visibility. Ozone can also impact vegetation by damaging leaves, decrease the productivity of some crops and may contribute to forest decline. It can also damage synthetic materials and textiles, cause cracks in rubber, accelerate fading of dyes and speed deterioration of some paints and coatings.

Improved air quality reduces heart attacks, hospital visits, allergy and child asthma attacks and prevents lost school and work days. Cleaner air can also reduce damage to crops, forests, surface waters and infrastructure such as buildings and bridges.[34]

Consult the Air pollution: drivers and impacts web page for information on the impacts of air pollution on human health, the economy and the environment.

Related initiatives

These indicators support the measurement of progress towards the following 2022 to 2026 Federal Sustainable Development Strategy Goal 11: Improve access to affordable housing, clean air, transportation, parks, and green spaces, as well as cultural heritage in Canada.

In addition, the indicators contribute to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. They are linked to the 2030 Agenda's Goal 11: Sustainable Cities and Communities and Target 11.6: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management."

Related indicators

The Population exposure to outdoor air pollutants indicator tracks the proportion of the population living in areas where outdoor concentrations of air pollutants are less than or equal to the 2020 Canadian Air Ambient Quality Standards.

The International comparison of urban air quality indicators present and compare the air quality in selected Canadian urban areas with a population greater than one million to the air quality in selected international urban areas having comparable data.

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[33] Health Canada (2021) Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes – 2021 Report. Retrieved on December 6, 2021.

[34] Canadian Council of Ministers of the Environment (2017) State of the Air. Retrieved on December 6, 2021.

The Air pollutant emissions indicators track emissions from human activities of 6 key air pollutants: sulphur oxides (SO_X), nitrogen oxides (NO_X), volatile organic compounds (VOCs), ammonia (NH_3), carbon monoxide (CO) and fine particulate matter ($PM_{2.5}$). Black carbon, which is a component of $PM_{2.5}$, is also reported. For each air pollutant, data are provided at the national, provincial/territorial and facility level and by major source.

The Air health trends indicator provides an overview of the public health impacts attributable to outdoor air pollution in Canada.

Data sources and methods

Data sources

The Air quality indicators are calculated from the air concentrations in the Canada-wide Air Quality Database. The database is maintained by Environment and Climate Change Canada's National Air Pollution Surveillance Program. It contains data collected through the following monitoring networks:

- the National Air Pollution Surveillance Network, a collaboration established in 1969 between Environment and Climate Change Canada and provincial, territorial and regional (Metro Vancouver, Ville de Montréal) governments
- the Canadian Air and Precipitation Monitoring Network operated by Environment and Climate Change Canada, for ground-level ozone
    - the Canadian Air and Precipitation Monitoring Network stations were established to research and monitor air pollution outside urban areas

More information

Air quality monitoring stations are spread across the country, but are more concentrated in urban areas. The indicators for fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and volatile organic compounds (VOCs) are provided nationally and by region. The regions used for these indicators are listed and shown in the following table and map. See Annex B for the full list of stations used to calculate the national and regional indicators.

Table 1. Regions used for the regional Air quality indicators

Region	Region code
Atlantic Canada	ATL
Southern Quebec	SQC
Southern Ontario	SON
Prairies and northern Ontario	PNO
British Columbia	BCO
Northern territories	TER

Figure 35. Regions used for the regional Air quality indicators

The Air quality indicators are also reported for the largest urban areas across Canada and the capitals of the provinces and territories when sufficient data are available. An urban area follows the definition of the Statistic Canada's population centres. Refer to Annex H for the full list of stations used to calculate the urban area indicators. Ambient levels of $PM_{2.5}$, O_3, SO_2, NO_2 and VOCs by monitoring station are also shown in the Canadian Environmental Sustainability Indicators interactive indicator maps.

Data quality assurance and quality control for the National Air Pollutant Surveillance program

Monitoring agencies contributing to the National Air Pollution Surveillance program all strive to adhere to established quality assurance and quality control standards, which are developed by Environment and Climate Change Canada in consultation with the provincial, territorial and regional governments participating in the program.

Ensuring data quality involves identifying the appropriate data quality objectives and methodologies that can be used to meet these objectives. The key data quality objectives for the National Air Pollution Surveillance program are:

- representativeness, referring to the degree to which data measurements represent a pollutant concentration of interest
- comparability, a measure of confidence with which one data set or method can be compared to another at other participating National Air Pollutant Surveillance program sites across Canada
- accuracy, the assessment of the overall agreement of a measurement with a known value (Table 2)
    - accuracy can include assessments of agreement among repeated measurements (precision) and measures of positive or negative systematic errors (bias)
- completeness, the assessment as to whether enough information is being collected to ensure confidence in conclusions or decisions made on the basis of data

Table 2. Accuracy data quality objectives for air pollutant samples

Parameter	Accuracy
Fine particulate matter	± 15%
Ground-level ozone	± 15%
Nitrogen dioxide	± 15%
Sulphur dioxide	± 15%
Volatile organic compounds	Species-dependent

Routine assessments of network operations provide assurance that the monitoring systems and data processing procedures produce an acceptable level of data quality to meet National Air Pollution Surveillance guidelines and to identify areas where improvements may be required. Three (3) main streams of audits and assessment are used in the National Air Pollution Surveillance network:

- performance and systems audits, which are conducted externally either by an Environment and Climate Change Canada auditor or by another agency separate from the monitoring agency
    - these audits are performed using independently verified reference standards and provide an unbiased quantitative assessment to defend the quality of the data
- interagency measurement program, which involves analysis by the monitoring agency of an unknown sample concentration provided by Environment and Climate Change Canada
    - these tests help verify instrument accuracy and help determine data comparability across sites
- data quality assessments, which involve the statistical analysis of environmental data to determine if collected and reported data meet network and data quality objectives

Additional audits and assessments are performed by Environment and Climate Change Canada's air quality laboratories in Ottawa for the analysis of integrated VOC samples. Consult the National Air Pollution Surveillance Monitoring and Quality Assurance and Quality Control Guidelines (PDF; 2.8 MB) for more information.

Methods

The Air quality indicators are calculated using air pollutant concentrations measured at monitoring sites and stored in the Canada-wide Air Quality Database. Specific calculations are done for each pollutant to establish indicators for the assessment of air quality at the national, regional and urban area levels (Table 3). Subsequent statistical analyses are conducted to determine the presence of a significant trend over a 15-year period for each national and regional air quality indicator.

More information

Table 3. Air quality indicators definitions

Indicator	Definition	Concentration measurement unit[A]
Average $PM_{2.5}$	Annual average of the daily 24-hour average concentrations	$\mu g/m^3$
Peak $PM_{2.5}$	Annual 98th percentile of the daily 24-hour average concentrations	$\mu g/m^3$
Average O_3	Annual average of the daily maximum 8-hour average concentrations	ppb
Peak O_3	Annual 4th-highest of the daily maximum 8-hour average concentrations	ppb
Average NO_2	Annual average of the hourly concentrations	ppb
Peak NO_2	Annual 98th percentile of the daily maximum 1-hour average concentrations	ppb
Average SO_2	Annual average of the hourly concentrations	ppb
Peak SO_2	Annual 99th percentile of the daily maximum 1-hour average concentrations	ppb
Average VOC	Annual average of the daily time-integrated concentrations (24 hour urban, 4 hour rural)	ppbC

Note: [A] Units: $\mu g/m^3$ = micrograms per cubic metre, ppb = parts per billion, ppbC = parts per billion carbon.

Average indicators are used to capture prolonged or repeated exposures over longer periods or chronic exposure while peak indicators are used to capture immediate or acute short-term exposures.

Canadian Ambient Air Quality Standards

In October 2012, the ministers of the environment, with the exception of Quebec,[35] agreed to begin implementing the Air Quality Management System. This system provides a comprehensive, cross-Canada framework for collaborative action to further protect human health and the environment through continuous improvement of air quality. Under the system, the Canadian Ambient Air Quality Standards (CAAQS, the standards) are drivers for air quality across the country. The CAAQS are health- and environment-based air quality objectives for pollutant concentrations in outdoor air. Together with the management levels,[36] the CAAQS act as a benchmark to support continuous improvement of air quality. The standards are not "pollute-up-to levels" and the Air Quality Management System encourages governments to take action to improve air quality, considering that some pollutants can affect human health even at concentrations below the standards.

[35] Although Quebec supports the general objectives of the Air Quality Management System, it will not implement the System since it includes federal industrial emission requirements that duplicate Quebec's regulation. However, Quebec is collaborating with jurisdictions on developing other elements of the system, notably air zones and airsheds.

[36] Management levels refer to the air zone management framework and threshold values. More information can be found in the Canadian Council of Ministers of the Environment's Guidance document on air zone management (PDF; 226 KB). Retrieved on December 6, 2021.

Under the *Canadian Environmental Protection Act, 1999*, the 2020 CAAQS were established:

- for $PM_{2.5}$ and O_3 in May 2013
- for SO_2 in October 2017
- for NO_2 in December 2017

The 2020 Canadian Ambient Air Quality Standards are presented in Table 4. Calculation of the Air quality indicators mostly follows the same data-handling conventions as those used in calculating the concentrations to use for comparison to the standards. Formal comparison to the standards to determine if concentrations exceed a standard can only be done using ambient concentrations as measured at individual monitoring stations and not using national or regional average concentrations. As such, comparisons of the indicator values (such as the national and regional average concentrations) to the standards are provided for illustrative purposes only and not for assessing whether the standards are achieved. Indicator values that are below a standard do not imply that concentrations at individual monitoring stations are also below the standard. Furthermore, the indicators are not adjusted for exceptional events (such as wildfires) or for pollution from transboundary flows.

Table 4. Canadian Ambient Air Quality Standards for fine particulate matter, ground-level ozone, nitrogen dioxide and sulphur dioxide

Pollutant	Averaging time	2020 Standard (numerical value)	Statistical form
$PM_{2.5}$	Annual (calendar year)	8.8 µg/m^3	The 3-year average of the annual average of the daily 24-hour average concentrations
$PM_{2.5}$	24-hour (calendar day)	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
O_3	8-hour	62 ppb	The 3-year average of the annual 4th-highest daily maximum 8-hour average concentrations
NO_2	Annual (calendar year)	17.0 ppb	The arithmetic average over a single calendar year of all 1-hour average concentrations
NO_2	1-hour	60 ppb	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
SO_2	Annual (calendar year)	5.0 ppb	The arithmetic average over a single calendar year of all 1-hour average concentrations
SO_2	1-hour	70 ppb	The 3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations

Data collection and validation

Data obtained from National Air Pollution Surveillance monitoring stations are converted to a format compatible with the Canada-wide Air Quality Database. All data in the Canada-wide Air Quality Database have a comparable level of quality because jurisdictions adhere to established quality assurance and quality control procedures as outlined in the National Air Pollution Surveillance Monitoring and Quality Assurance/Quality Control Guidelines (PDF; 2.8 MB). These procedures include site and sampling system design, use of monitoring methods that meet defined minimum performance specifications, operation, maintenance and calibrations and data validation techniques. National Air Pollution Surveillance monitoring organizations are responsible for submitting quality-assured data, as per the specifications in the Guidelines, to the Canada-wide Air Quality Database. Data submitted to the National Air Pollution

Surveillance database are in the hour-ending format (that is, minute data collected between 01:01 and 02:00 are averaged and reported as the 02:00 hour).

Data completeness criteria

The following criteria are used to determine which stations have sufficient hourly and daily measurements in each year to be considered valid for inclusion in the indicators.

Fine particulate matter ($PM_{2.5}$)

For the annual (calendar year) average $PM_{2.5}$ indicator:

- a daily 24-hour average concentration was considered valid if at least 75% (18 hours) of the 1-hour concentrations were available on a given day
- an annual average concentration was considered valid if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter[37] of a calendar year

For the peak (98th percentile) 24-hour (calendar day) $PM_{2.5}$ indicator:

- a daily 24-hour average concentration was considered valid if at least 75% (18 hours) of the 1-hour concentrations were available on a given day
- a 98th percentile of the daily average concentration was considered valid if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter[38] of a calendar year
- a station was also included if it exceeded the 24-hour standard of 28.0 micrograms per cubic metre ($\mu g/m^3$), even if the above data completeness criteria were not satisfied

Ground-level ozone (O_3)

For the annual average O_3 indicator:

- rolling (or moving) 8-hour average concentrations were calculated for each hour of the day from the 1-hour average concentrations, resulting in up to 24 8-hour average concentrations per day
- to be valid a rolling 8-hour average concentration must have at least 6 1-hour average concentrations
- a daily maximum 8-hour average concentration was considered valid if at least 75% (18) of the 8-hour rolling average concentrations were available in the day
- the annual maximum 8-hour average concentration was considered valid if at least 75% of all daily maximum 8-hour average concentrations were available for the period from April 1 to September 30

For the peak (4th-highest) 8-hour O_3 indicator:

- rolling (or moving) 8-hour average concentrations were calculated for each hour of the day from the 1-hour average concentrations, resulting in up to 24 8-hour average concentrations per day
- to be valid a rolling 8-hour average concentration must have at least 6 1-hour average concentrations
- a daily maximum 8-hour average concentration was considered valid if at least 75% (18) of the 8-hour rolling average concentrations were available in the day
- the annual 4th-highest daily maximum 8-hour average concentration was considered valid if there were at least 75% of all daily maximum 8-hour average concentrations in the period from April 1 to September 30
- a station was also included if it exceeded the 8-hour standard of 63 parts per billion (ppb), even if the above data completeness criteria were not satisfied

Nitrogen dioxide (NO_2)

For the annual (calendar year) average NO_2 indicator:

[37] The quarters are as follows: quarter 1 from January 1 to March 31; quarter 2 from April 1 to June 30; quarter 3 from July 1 to September 30 and quarter 4 from October 1 to December 31.

[38] The quarters are as follows: quarter 1 from January 1 to March 31; quarter 2 from April 1 to June 30; quarter 3 from July 1 to September 30 and quarter 4 from October 1 to December 31.

- an annual average concentration was considered valid if at least 75% of all the 1-hour average concentrations were available for the year and at least 60% were available in each quarter

For the peak (98th percentile) 1-hour NO_2 indicator:

- the daily maximum 1-hour average concentration was considered valid if at least 75% (18) of the hourly concentrations were available on a given day
- the 98th percentile of the daily maximum 1-hour average concentrations was considered valid if at least 75% of the daily maximum 1-hour average concentrations for the year were available and at least 60% in each quarter were available
- a station was also included if it exceeded the 1-hour standard of 60 ppb, even if the above data completeness criteria were not satisfied

Sulphur dioxide (SO_2)

For the annual (calendar year) average SO_2 indicator:

- an annual average concentration was considered valid if at least 75% of all the 1-hour average concentrations were available for the year and at least 60% were available in each quarter

For the peak (99th percentile) 1-hour SO_2 indicator:

- the daily maximum 1-hour average concentration was considered valid if at least 75% (18 hours) of the hourly concentrations were available on a given day
- the annual 99th percentile of the daily maximum 1-hour average concentrations was considered valid if at least 75% of all the daily maximum 1-hour average concentrations for the year were available and at least 60% in each quarter were available
- a station was also included if it exceeded the 1-hour standard of 70 ppb, even if the above data completeness criteria were not satisfied

Volatile organic compounds (VOCs)

There are fewer data available for VOCs and therefore the data completeness criteria for this indicator are different. At urban monitoring stations, VOC samples are usually collected over a 24-hour period once every 6 days; conversely at rural stations, samples are collected over a 4-hour sampling period (12:00 to 16:00) once every 3 days.[39]

For the annual (calendar year) average VOC indicator:

- a daily average concentration was considered valid if data for a consecutive period of 24 hours (± 1 hour) at an urban station and for a consecutive 4 hours (± 0.5 hours) at a rural station were available on a given day and a quarter (3 months) had at least 5 samples
- a station was only included if there were 3 valid quarters in the year

After the data completeness criteria have been met, the pollutant concentrations are calculated for the selected stations.

Table 5. Number of stations that satisfied the data completeness criteria

Air pollutant	Number of stations
Average $PM_{2.5}$	205
Peak (98th percentile) 24-hour $PM_{2.5}$	207
Average O_3	217
Peak (4th-highest) 8-hour O_3	217
Average NO_2	179
Peak (98th percentile) 1-hour NO_2	178
Average SO_2	124
Peak (99th percentile) 1-hour SO_2	124

[39] As of 2018, all rural stations were switched to a once-every-6-day collection schedule.

Air pollutant	Number of stations
VOCs	37

Pollutant-specific calculations

Fine particulate matter

Fine particulate matter concentrations are expressed in micrograms per cubic metre (µg/m^3). The $PM_{2.5}$ average and peak (98th percentile) 24-hour indicators are based on the 24-hour daily average concentrations (daily average) for the whole year. The daily average value for $PM_{2.5}$ is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid daily averages and dividing by the number of valid days. The peak (98th percentile) 24-hour indicator is obtained by determining the 98th percentile value of all 24-hour daily values for a given year. The 98th percentile value corresponds to the concentration for which 98% of all the daily 24-hour values are less than or equal to it and 2% are greater than or equal to it. For example, the 98th percentile value of 25 µg/m^3 at a given station means that 98% of all daily 24-hour average concentrations are less than or equal to 25 µg/m^3 and only 2% are greater than or equal to 25 µg/m^3. In a year with a complete dataset, the 98th percentile corresponds to the 8th highest value. The following table provides the rank of the 98th percentile value based on the number of available daily measurements.[40]

Table 6. 98th percentile rank based on the number of available measurements

Number of available daily measurements in a year	98th percentile rank
274 to 300	6th highest
301 to 350	7th highest
351 to 366	8th highest

The urban area, regional and national indicators (average and peak [98th percentile] 24-hour) for $PM_{2.5}$ are calculated by averaging the station-level annual average and station-level annual peak values for all stations that met the completeness criteria within either the urban area, the region or Canada as a whole.

Ground-level ozone

Ozone concentrations are expressed in parts per billion (ppb). There are 24 consecutive 8-hour average concentrations (8-hour rolls) that can possibly be calculated for each day. The highest value of the 24 8-hour average concentrations per day is the daily maximum. An illustration of the calculation running 8-hour average concentrations and the selection of the daily maximum is provided in Figure 36.

[40] To obtain the 98th percentile values shown in this table, the calculation method proposed in section 4.1.2 of the Canadian Council of Ministers of the Environment's Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone was used.

Figure 36. Calculation of the ground-level ozone daily maximum 8-hour average concentration

Date	Hour	1-hour (parts per billion)	8-hour (parts per billion)	Daily maximum 8-hour (parts per billion)
03/25	17:00	44		
	18:00	45		
	19:00	44		
	20:00	42		
	21:00	39		
	22:00	33		
	23:00	20		
	24:00	14		
03/26	01:00	11	31.0	45.6
	02:00	11	26.8	
	03:00	15	23.1	
	04:00	13	19.5	
	05:00	19	17.0	
	06:00	21	15.5	
	07:00	19	15.4	
	08:00	11	15.0	
	09:00	30	17.4	
	10:00	36	20.5	
	11:00	39	23.5	
	12:00	42	27.1	
	13:00	44	30.3	
	14:00	46	33.4	
	15:00	47	36.9	
	16:00	47	41.4	
	17:00	47	43.5	
	18:00	46	44.8	
	19:00	46	45.6	
	20:00	42	45.6	
	21:00	39	45.0	
	22:00	38	44.0	
	23:00	38	42.9	
	24:00	35	41.4	

For each station, the average O_3 indicator is calculated by taking the average of the daily maximum 8-hour (ending) averages for the period from January 1 to December 31. The urban area, regional and national averages for O_3 are obtained by averaging the station-level annual averages for selected stations within the urban area, the region or Canada as a whole.

For each station, the peak (4th-highest) 8-hour O_3 indicator is based on the 4th-highest of the daily maximum 8-hour average concentrations measured over a given year. All of the daily maximum 8-hour average concentrations are ordered in an array from highest to lowest, with equal values repeated as often as they occur. Each value is assigned a rank. For a given year, the 4th-highest ranking value in the array is identified as the annual peak (4th-highest) 8-hour O_3 concentration for that station.

The urban area, regional and national peak O_3 indicators are obtained by averaging all 4th-highest values from all stations that met the completeness criteria within either the urban area, the region or Canada as a whole.

Nitrogen dioxide

Nitrogen dioxide concentrations are expressed in parts per billion (ppb). The NO_2 average indicator is based on the annual average of all 1-hour concentrations while the peak (98th percentile) 1-hour indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations. The daily maximum 1-hour average value for NO_2 is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid 1-hour averages and dividing by the number of total hours. The peak (98th percentile) 1-hour indicator is obtained by determining the 98th percentile value of all daily maximum 1-hour average for a given year. The 98th percentile value corresponds to the concentration for which 98% of all the daily maximum values are less than or equal to it and 2% is greater than or equal to it. For example, the 98th percentile value of 25 ppb at a given station means that 98% of all daily maximum 1-hour average concentrations are less than or equal to 25 ppb and only 2% are greater than or equal to 25 ppb.

The national, regional and urban area indicators (average and peak [98th percentile] 1-hour) for NO_2 are calculated by averaging the station-level annual average and station-level annual peak values for all stations that met the completeness criteria within either the urban area, the region or Canada as a whole.

Sulphur dioxide

Sulphur dioxide concentrations are expressed in parts per billion (ppb). The SO_2 average indicator is based on the annual average of the 1-hour concentrations while the peak (99th percentile) 1-hour indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations. The daily maximum 1-hour average value for SO_2 is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid 1-hour averages and dividing by the number of total hours. The peak (99th percentile) 1-hour indicator is obtained by determining the 99th percentile value of all daily maximum 1-hour concentrations for a given year. The 99th percentile value corresponds to the concentration for which 99% of all the daily maximum 1-hour concentrations are less than or equal to and 1% are greater than or equal to it. For example, the 99th percentile value of 65 ppb at a given station means that 99% of all daily maximum 1-hour average concentrations are less than or equal to 65 ppb and only 1% are greater than or equal to 65 ppb. In a year with a complete dataset, the 99th percentile corresponds to the 4th highest value. The following table provides the rank of the 99th percentile value based on the number of available daily measurements.

Table 7. 99th percentile rank based on the number of available measurements

Number of available daily measurements in a year	99th percentile rank
274 to 300	3rd highest
301 to 366	4th highest

The national and regional indicators (average and peak [99th percentile] 1-hour) for SO_2 are calculated by averaging the station-level annual average and station-level annual peak values for all stations that met the completeness criteria within the region or throughout Canada.

Volatile organic compounds

Volatile organic compounds are reported as a daily sum of individual compounds, as described in Annex E. The number of compounds included in the reported sum may slightly vary subject to the analytical validity of the individual compound concentrations. Urban VOC station indicators are calculated from the average of daily total VOC concentrations (24-hour time-integrated concentrations) while rural VOC station indicators are calculated from the average of daily 4-hour total VOC concentrations (time-integrated samples collected from 12:00 to 16:00). The daily 24-hour average concentrations are based on measurements taken from midnight to midnight. For a station, the average indicator is calculated by taking the average of the daily total concentrations for a given year.

The national and regional indicators for VOCs are obtained by averaging the station-level annual averages from all stations that met the completeness criteria within the region and throughout Canada.

While the concentration unit for individual VOCs is usually expressed as micrograms per cubic metre ($\mu g/m^3$), parts per billion carbon (ppbC) are used in this indicator to assess the quantity of mixed VOC species.

Station selection criteria for inclusion in national and regional indicators (time-series)

Station-level indicators were calculated for the years 2005 to 2019 for all air pollutants. Each station was then assessed for its suitability (sufficient data, no large gaps at the beginning or end) for inclusion in the national and regional time series. The specific criteria are as follows:

- for the national and regional time series, a station is included if it satisfies the data completeness criteria for at least 11 of the 15 years
- stations are included if data are available for at least 1 of 3 years at the beginning or end of the time series

- this measure avoids the use of data from stations that were commissioned or decommissioned at the beginning or end of the time series

In addition to the time series selection criteria, a minimum of 3 monitoring stations are required to calculate the indicator for a region, for a given year's trend.

Station selection results

The following table indicates the number of monitoring stations that satisfied the selection criteria (data completeness and time series) for the 2019 reporting year and were thus included in the time series for the national and regional Air quality indicators (Table 8). Further details on the stations selected are available in Annex B.

Table 8. Number of stations selected for the national and regional Air quality indicators

Air pollutant	Canada	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia	Northern territories
Average $PM_{2.5}$	145	11	36	39	33	24	0
Peak (98th percentile) 24-hour $PM_{2.5}$	147	11	36	39	33	25	3
Average O_3	171	21	41	42	34	30	3
Peak (4th-highest) 8-hour O_3	171	21	41	42	34	30	3
Average NO_2	119	7	14	30	37	29	0
Peak (98th percentile) 1-hour NO_2	120	8	14	30	37	29	0
Average SO_2	80	4	9	10	32	23	0
Peak (99th percentile) 1-hour SO_2	81	5	9	10	32	23	0
VOCs	30	4	5	9	5	7	0

Note: The sum of the regional stations may not match the national station numbers because a minimum of 3 monitoring stations are required to calculate the indicator for a region. Where there were not enough stations in the northern territories region, results from stations located in this region (Yukon and the Northwest Territories) were only included in the national totals.

Local (station-level) indicators for O_3, $PM_{2.5}$, NO_2, SO_2 and VOCs are also presented in the Canadian Environmental Sustainability Indicators interactive indicator maps. All stations displayed on the map satisfy the data completeness criteria.

Imputation

Stations that do not have enough measurements to meet the 15-year time series criteria are excluded from the national and regional indicators. However, in some cases, monitoring stations are located close enough to others to allow data from neighbouring stations to be used to supplement missing data. Stations that were moved but remain relatively close to their previous location were also included. Annex C provides details on the stations that were used for imputation in the calculation of the time series.

Monitoring equipment

Fine particulate matter monitoring equipment

Six (6) types of monitoring equipment are used to monitor ambient $PM_{2.5}$ concentrations:

- older technology: Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitor
- current technology: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor

- current technology: Met One BAM-1020 Beta Attenuation Mass monitor
- current technology: Thermo Scientific 5030 or 5030i SHARP (Synchronized Hybrid Ambient Real-time Particulate) monitor
- current Technology: GRIMM Environmental Dust Monitor model EDM 180
- current technology: Teledyne Advanced Pollution Instrumentation Model T640 PM mass monitor

The current technologies have been approved by the United States Environmental Protection Agency as Class III Federal Equivalent Methods and have been deployed across the National Air Pollution Surveillance network replacing older TEOM instruments that have been found to exclude a portion of the $PM_{2.5}$ mass from measurement. Further details on this technological transition are available in Annex D.

Ground-level ozone monitoring equipment

Ozone measurements are made using ultraviolet photometry. Sample air passes through a beam of light from an ultraviolet lamp, which is absorbed by O_3. The amount of ultraviolet light absorbed is proportional to the amount of O_3 in the sample.

Nitrogen dioxide monitoring equipment

Nitrogen dioxide is calculated by subtraction following the measurement of total of nitrogen oxides (NO_X) and nitrogen monoxide (NO). Nitrogen monoxide (NO) concentrations are determined photometrically by measuring the light intensity from the chemiluminescent reaction of NO mixed with excess O_3. The chemiluminescence method detects only NO, therefore, NO_2 must first be converted to NO for measurement purposes. Sample flow is either directed through a converter to reduce NO_2 to NO, or it bypasses the converter to allow detection of only NO. The sample stream with reduced NO_2 is a measurement of NO plus NO_2, which is expressed as NO_X (that is, $NO_X = NO_2 + NO$). The difference between NO_X and NO detection is taken as the NO_2 concentration (that is, $NO_2 = NO_X - NO$).

Sulphur dioxide monitoring equipment

Sulphur dioxide measurements are made using pulse-fluorescence ultraviolet adsorption instruments. This technology is based on the principle that SO_2 molecules absorb ultraviolet light at one wavelength and emit ultraviolet light at a different wavelength. The intensity of the emitted light is proportional to the number of SO_2 molecules in the sample gas.

Volatile organic compound monitoring equipment

A combined gas chromatography-flame ionization detector system is used for quantification of VOCs containing 2 carbons, while a combined gas chromatography-mass selective detector system operating in selected ion monitoring mode is used for quantification of VOCs containing 3 to 12 carbons. Approximately 120 VOCs (including a number of biogenic species such as isoprene and pinenes) are targeted for quantification in the samples, but not all VOCs are detectable in each sample. The total concentration of VOCs in parts per billion carbon is calculated from the total mass of 77 of these species when detectable in the sample. The list of VOCs targeted for quantification is provided in Annex E. Air samples are collected in either 6-litre or 3.2-litre stainless steel canisters. The canisters are then shipped to the Environment and Climate Change Canada analysis laboratory in Ottawa.

Statistical analysis

Non-parametric statistical tests were carried out on temporal concentration data to detect the presence of a linear trend and, if present, to determine the orientation (positive or negative) and magnitude of the rate of change (slope). The standard Mann-Kendall trend test was used to detect trend presence and orientation, while the Sen's pairwise slope method was used to estimate the slope. Both tests were applied to the national and regional data for $PM_{2.5}$, O_3, NO_2, SO_2 and VOCs. A trend was reported when the Mann-Kendall test indicated the presence of a trend at the 95% confidence level over the 15-year time series. Results of the tests are available in Annex G, with "Significant" expressing the presence and level of confidence of a trend and "Q" the slope.

Percentile bounds

A percentile is a statistical measure used to indicate the value below which a percentage of the data falls. For example, the 10th percentile is the value below which 10% of the data may be found. Likewise, the 90th percentile is the value below which 90% of the data may be found.

A percentile range is the difference between 2 determined percentiles. The 10th to 90th percentile range is the most common and is referred to as the 10th to 90th percentile bounds in the Air quality indicators. If sufficient data values are available, the bounds capture 80% of the data. When few data values are available, the calculated percentile range may vary greatly from one year to the next or may not be visible for a given year. This can be observed in the results for the northern territories region or for some regions in the regional VOC indicator.

Calculation of the urban area indicators

The urban areas used in the indicators are defined by population centres determined by Statistics Canada. A population centre is an area consisting of a population of at least 1 000 and a population density of 400 persons or more per square kilometre, based on population counts from the current Census of Population. All areas outside the population centres are classified as rural areas.

All the monitoring stations located within the population centre are considered in the calculation only if they meet the same data completeness criteria used for the national and regional indicators. Refer to the section on data completeness criteria for more information.

Annual ambient levels from all monitoring stations found within the urban area are averaged. The average is a simple arithmetic average and is not weighted by the population covered by each station. This calculation is repeated for each indicator.

The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when sufficient data was available. Data for the SO_2 and VOC indicators were considered too sparse to allow for appropriate urban area comparisons. For a complete list of the urban areas and monitoring stations found in these urban areas, consult Annex H.

Recent changes

The stations used to calculate the indicators vary slightly between different iterations of the indicators. For more information, consult the caveats and limitations section under Revisions to station selections. Some air quality data of previous years were reassessed and corrected.

The national and regional indicator figures were updated to include a shaded band. This shaded band represents the 10th and 90th percentile bounds of concentrations across monitoring stations in Canada or within a region. This revision better illustrates that although national and regional concentrations are often below the 2020 Canadian Ambient Air Quality Standards (CAAQS), there are monitoring stations with concentrations that exceed the CAAQS.

In this iteration of the indicators, urban area regions were redefined using population centres rather than census metropolitan areas and census agglomerations. Using population centres focuses the analyses on monitoring stations located in urban areas with the highest population densities. Census metropolitan area and census agglomeration regions can be quite large and in some cases included rural stations. For some urban areas this change reduced the number of monitoring stations used to calculate the concentration. This change is consistent with reporting to the World Health Organization and provides a more accurate representation of air quality concentrations in each urban area.

Caveats and limitations

Data values presented in the Air quality indicators may differ from values calculated using the data presented in Annex A due to rounding.

Data completeness

Some data collected at stations cannot be used in calculating the indicators because the data do not meet the data completeness criteria. These criteria are based on standard practices supported by expert opinion and are

used by a number of organizations, such as the World Health Organization, the Canadian Council of Ministers of the Environment and the United States Environmental Protection Agency. The criteria allow for some gaps in data.

More information

Revisions to station selections

Monitoring stations are selected based on the 15-year time series criteria for the calculation of the Air quality indicators. As this is a rolling 15-year time period, the number of stations selected may vary from 1 iteration of the indicators to the next and may change the historical trends. Caution should be exercised when comparing different iterations of the Air quality indicators.

The following table shows the number of stations removed, added, relocated or combined for fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and volatile organic compound (VOC) indicators.

Table 9. Number of stations removed and number of new stations compared to the 2018 release of the Air quality indicators

Air pollutant	Number of stations removed[A]	Number of new or relocated stations	Number of stations used for the imputation	Number of combined stations after imputation[B]
Average $PM_{2.5}$	12	45	48	23
Peak (98th percentile) 24-hour $PM_{2.5}$	6	52	50	24
Average O_3	15	35	62	29
Peak (4th-highest) 8-hour O_3	14	38	62	29
Average NO_2	8	45	41	20
Peak (98th percentile) 1-hour NO_2	10	35	43	21
Average SO_2	7	25	21	10
Peak (99th percentile) 1-hour SO_2	4	31	23	11
Average VOCs	11	4	19	9

Note: [A] These stations no longer respect the data completeness and time series criteria as single or combined trend stations and were removed from the calculation of the national and regional indicators for the whole time series. [B] These stations were included in the calculation of the national and regional indicators. Annex C provides details on the stations that were used for imputation.

Regional air quality indicators

The number of available monitoring stations and pollutants measured varies from region to region. In certain years, regions that have close to the minimum number of monitoring stations required may report an unusual value if a particular monitoring station did not meet the completeness criteria for that year. This is especially true when the value obtained is an outlier from those obtained at other stations (value overshadows all other stations in the region). For this reason, the regional indicator may be subject to annual fluctuations in some regions (for example, the northern territories).

Effect of new fine particulate matter measurement technologies

Since 2005, the Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitors used in the National Air Pollution Surveillance program have gradually been replaced by newer monitoring technologies (federal equivalency method-approved instruments). Many studies conducted in Canada, the United States and other countries have found that the TEOM monitors under-report concentrations

compared with the newer monitors, especially when the air contains a large proportion of semi-volatile particulate matter. This may be the case during cooler seasons when the air contains a greater proportion of ammonium nitrate and semi-volatile organic compounds.

Some of the year-to-year variations in the $PM_{2.5}$ air quality indicator may be due, in part, to the introduction of the newer monitoring technologies across the National Air Pollution Surveillance Network rather than to changes in actual ambient concentrations only. As such, trends in $PM_{2.5}$ concentrations may not be a true reflection of the changes that have occurred over the time period concerned (see Annex D).

Resources

References

Canadian Council of Ministers of the Environment (2011) Ambient Air Monitoring Protocol for $PM_{2.5}$ and Ozone.

Canadian Council of Ministers of the Environment (2017) Air Quality Management System. Retrieved on December 6, 2022.

Canadian Council of Ministers of the Environment (2019) Ambient air monitoring and quality assurance/quality control guidelines: National Air Pollution Surveillance Program (PDF; 2.8 MB). Retrieved on December 6, 2022.

Dann T (2012) CESI $PM_{2.5}$ Air Indicator Using Transformed Data. Prepared for Environment Canada.

Dann T (2013) Comparison of CESI $PM_{2.5}$ Air Indicators with Transformed Data (FEM Basis). Prepared for Environment Canada.

Environment and Climate Change Canada (2020) National Air Pollution Surveillance Program. Retrieved on December 6, 2022.

Related information

Air pollution: drivers and impacts

Canada's air

Canadian Smog Science Assessment Highlights and Key Messages

Smog: causes and effects

Annexes

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Air quality problems such as smog and acid rain result from the release of pollutants into the atmosphere. The majority of these pollutants come from human activities, such as transportation, the burning of fuels for electricity and heating, and industry. Pollutants from natural sources, such as wildfires, can sometimes be substantial. Air pollutants cause adverse health and environmental effects. The Air quality indicators present the concentrations of 5 key air pollutants for Canada.

National air quality trends

This section presents a summary of outdoor air quality trends for 5 air pollutants averaged across monitoring stations in Canada: fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and volatile organic compounds (VOCs). Air quality trends are measured by average and peak ambient levels (concentrations) of $PM_{2.5}$, O_3, NO_2, SO_2 and VOCs. Average concentrations capture chronic, prolonged or repeated exposure to air pollutants over longer time periods, while peak concentrations capture immediate or acute short-term exposure to air pollutants.

Key results

Between 2005 and 2019,

- average $PM_{2.5}$ concentrations have remained mostly unchanged with slight year-to-year fluctuations and a dip in 2019
- peak $PM_{2.5}$ concentrations exhibited variable results, decreasing after 2005 but trending upward over the past decade and decreasing again in 2019
- average O_3 concentrations fluctuated above and below 2005 levels, while peak O_3 concentrations have generally decreased
- average and peak NO_2, SO_2 and average VOC concentrations have decreased steadily

Figure 1. Relative air pollutant concentration changes, Canada, 2005 to 2019

Year	Fine particulate matter average concentration (percentage change from 2005 level)	Fine particulate matter peak (98th percentile) 24-hour concentration (percentage change from 2005 level)	Ground-level ozone average 8-hour concentration (percentage change from 2005 level)	Ground-level ozone peak (4th highest) 8-hour concentration (percentage change from 2005 level)	Nitrogen dioxide average concentration (percentage change from 2005 level)	Nitrogen dioxide peak (98th percentile) 1-hour concentration (percentage change from 2005 level)	Sulphur dioxide average concentration (percentage change from 2005 level)	Sulphur dioxide peak (99th percentile) 1-hour concentration (percentage change from 2005 level)	Volatile organic compounds concentration (percentage change from 2005 level)
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	-11.1	-21.9	-0.5	-2.8	-8.7	-9.0	-3.9	-9.2	8.5
2007	-13.0	-18.4	0.5	1.5	-10.7	-9.6	-9.0	-18.4	3.3
2008	-11.3	-25.7	-1.3	-5.2	-15.6	-9.2	-15.2	-20.6	3.5
2009	-15.3	-30.8	-2.7	-9.0	-18.5	-11.5	-24.7	-25.0	6.0
2010	-0.5	-6.5	1.1	-6.1	-23.4	-15.0	-37.6	-25.8	-8.2

2011	-5.2	-23.7	1.2	-9.6	-25.7	-16.1	-37.9	-49.2	-10.6
2012	-6.6	-25.9	2.8	-4.3	-30.5	-22.5	-39.2	-45.4	-24.0
2013	3.1	-21.6	1.0	-10.6	-30.2	-19.6	-41.4	-45.5	-22.5
2014	8.0	-11.9	0.6	-13.9	-30.6	-17.1	-46.3	-53.3	-21.6
2015	6.9	-10.7	1.1	-7.3	-33.8	-20.5	-53.3	-57.2	-21.8
2016	-7.0	-21.9	-1.1	-10.6	-36.7	-24.8	-56.7	-55.2	-34.6
2017	0.6	2.1	2.4	-9.9	-35.5	-23.8	-59.0	-55.9	-24.8
2018	10.0	24.3	3.6	-6.0	-35.6	-20.5	-63.4	-59.5	-35.4
2019	-9.1	-29.2	0.1	-15.4	-37.9	-22.8	-63.7	-64.0	-33.4

Note: For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.2. Data for Figure 2. National average fine particulate matter concentrations, Canada, 2005 to 2019

Year	Average concentration (micrograms per cubic metre)
2005	6.7
2006	6.0
2007	5.9
2008	6.0
2009	5.7
2010	6.7
2011	6.4
2012	6.3
2013	6.9
2014	7.3
2015	7.2
2016	6.3
2017	6.8
2018	7.4
2019	6.1
2020 standard	**8.8**

Year	Average concentration (micrograms per cubic metre)
Annual trend	**No trend**

Note: The national average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations for $PM_{2.5}$ recorded at 145 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.3. Data for Figure 3. Regional average fine particulate matter concentrations, Canada, 2005 to 2019

Year	Atlantic Canada average concentration (micrograms per cubic metre)	Southern Quebec average concentration (micrograms per cubic metre)	Southern Ontario average concentration (micrograms per cubic metre)	Prairies and northern Ontario average concentration (micrograms per cubic metre)	British Columbia average concentration (micrograms per cubic metre)
2005	4.3	8.6	8.5	4.2	5.5
2006	4.7	6.8	7.2	4.8	5.3
2007	4.4	6.8	7.2	4.6	4.8
2008	4.8	7.8	6.5	4.6	4.8
2009	5.4	7.5	5.5	4.7	5.0
2010	5.2	7.8	5.8	8.1	5.3
2011	6.1	7.7	6.0	7.0	4.5
2012	5.3	7.7	5.9	6.6	4.9
2013	6.0	7.5	7.7	6.4	6.1
2014	6.2	7.2	8.0	6.8	7.0
2015	6.0	7.1	7.8	7.0	7.2
2016	5.7	6.2	6.5	6.8	5.7
2017	5.5	6.5	6.4	6.6	8.7
2018	5.1	6.5	6.8	8.8	9.2
2019	5.0	6.2	6.4	6.1	6.2
2020 standard	**8.8**	**8.8**	**8.8**	**8.8**	**8.8**
Annual trend	**No trend**	**-0.1**	**No trend**	**No trend**	**0.2**

Note: The regional average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 11 monitoring stations in Atlantic Canada, 36 in southern Quebec, 39 in southern Ontario, 33 in the Prairies and northern Ontario region and 24 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.4. Data for Figure 4. Average fine particulate matter concentrations, selected Canadian urban areas, 2019

Urban area	2005 (micrograms per cubic metre)	2006 (micrograms per cubic metre)	2007 (micrograms per cubic metre)	2008 (micrograms per cubic metre)	2009 (micrograms per cubic metre)	2010 (micrograms per cubic metre)	2011 (micrograms per cubic metre)	2012 (micrograms per cubic metre)
Whitehorse, YT	2.8	n/a	n/a	1.8	n/a	1.9	2.5	5.6
Regina, SK	4.2	4.6	4.5	4.6	4.9	7.3	7.7	6.1
Yellowknife, NT	3.3	1.4	1.9	5.1	4.3	n/a	6.2	6.2
Fredericton, NB	4.3	4.3	3.8	4.0	n/a	3.9	5.2	4.8
Halifax, NS	4.4	n/a	3.1	4.7	4.5	5.6	6.0	5.7
St. John's, NL	4.0	3.5	2.8	3.3	4.5	5.0	5.9	3.8
Winnipeg, MB	4.6	4.9	4.7	4.5	4.4	5.8	7.2	6.7
Vancouver, BC	5.4	4.8	4.6	4.5	4.9	4.0	4.2	4.1
Ottawa, ON	7.5	6.1	5.9	5.2	4.5	4.4	4.7	4.9
Oshawa, ON	n/a	6.8	6.8	6.3	5.2	5.6	5.4	5.5
London, ON	11.9	8.8	6.5	6.8	5.7	n/a	6.2	6.4
Victoria, BC	5.4	6.3	5.1	5.3	7.1	8.2	7.9	7.0
St. Catharines - Niagara Falls, ON	8.6	7.8	8.2	7.4	6.0	6.5	6.3	6.3
Calgary, AB	4.7	6.0	5.0	4.4	n/a	11.5	10.9	10.0
Toronto, ON	9.0	7.6	7.8	7.0	5.6	6.1	6.4	6.3
Kitchener, ON	9.5	7.7	8.0	7.1	5.8	6.3	6.2	6.1
Gatineau, QC	8.3	6.3	6.1	n/a	n/a	7.2	8.0	9.5
Montreal, QC	10.1	7.8	7.5	11.9	11.0	10.4	10.1	9.6
Quebec, QC	9.3	8.1	6.7	7.1	n/a	9.8	9.2	10.1
Edmonton, AB	5.4	5.7	5.3	6.4	7.6	13.6	9.2	8.6
Barrie, ON	8.0	6.7	6.9	6.1	5.2	5.4	5.7	5.6
Saskatoon, SK	3.6	4.1	3.6	4.0	4.0	6.9	5.5	5.9
Hamilton, ON	9.6	8.3	8.0	7.5	6.3	6.7	7.0	7.1
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Windsor, ON	10.5	8.7	9.7	8.6	7.3	7.8	7.8	7.5

Urban area	2013 (micrograms per cubic metre)	2014 (micrograms per cubic metre)	2015 (micrograms per cubic metre)	2016 (micrograms per cubic metre)	2017 (micrograms per cubic metre)	2018 (micrograms per cubic metre)	2019 (micrograms per cubic metre)
Whitehorse, YT	6.2	n/a	5.5	3.4	4.3	3.3	n/a
Regina, SK	6.6	6.6	11.0	8.1	6.3	6.7	4.4
Yellowknife, NT	6.4	15.8	8.5	7.8	4.5	2.9	4.4
Fredericton, NB	4.3	5.2	5.8	5.8	n/a	5.6	4.8
Halifax, NS	6.7	5.2	4.3	5.0	5.7	5.3	4.8
St. John's, NL	5.3	7.0	5.8	5.1	5.1	4.7	4.8
Winnipeg, MB	6.2	5.9	6.0	5.8	5.3	5.9	5.4
Vancouver, BC	6.1	6.0	6.1	4.8	6.5	6.8	5.4
Ottawa, ON	7.1	6.9	6.9	5.8	5.9	5.9	5.9
Oshawa, ON	7.4	7.7	7.5	5.9	5.9	6.4	6.1
London, ON	9.1	8.7	8.3	7.1	7.0	7.2	6.7
Victoria, BC	7.5	5.9	6.3	4.3	6.9	8.4	6.8
St. Catharines - Niagara Falls, ON	8.5	n/a	8.5	6.9	7.0	7.0	6.9
Calgary, AB	8.1	8.2	8.1	5.2	7.9	11.2	7.1
Toronto, ON	8.3	8.8	8.5	7.3	7.4	7.6	7.2
Kitchener, ON	8.7	9.3	8.8	7.3	7.0	7.3	7.2
Gatineau, QC	8.5	7.2	6.3	6.7	n/a	6.6	7.2
Montreal, QC	9.9	8.6	8.5	7.2	7.7	7.8	7.3
Quebec, QC	9.3	9.2	9.1	8.2	8.0	7.9	7.3
Edmonton, AB	7.9	10.2	8.6	6.8	7.5	10.4	7.5
Barrie, ON	7.5	7.6	7.6	6.5	7.0	7.7	7.5
Saskatoon, SK	6.4	8.2	10.6	6.8	8.8	10.7	7.8
Hamilton, ON	9.4	10.0	9.7	7.8	7.6	8.1	7.9
Charlottetown, PE	n/a	n/a	4.3	n/a	n/a	n/a	8.0
Windsor, ON	9.6	10.4	9.6	8.3	8.1	8.6	8.4

Note: n/a = not available. The 2019 concentration presented in the figure for Whitehorse was from 2018. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information.

Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.5. Data for Figure 6. National peak fine particulate matter concentrations, Canada, 2005 to 2019

Year	Peak (98th percentile) 24-hour concentration (micrograms per cubic metre)
2005	24.2
2006	18.9
2007	19.7
2008	18.0
2009	16.7
2010	22.6
2011	18.5
2012	17.9
2013	19.0
2014	21.3
2015	21.6
2016	18.9
2017	24.7
2018	30.1
2019	17.1
2020 standard	**27**
Annual trend	**No trend**

Note: The national peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 147 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.6. Data for Figure 7. Regional peak fine particulate matter concentrations, Canada, 2005 to 2019

Year	Atlantic Canada peak (98th percentile) concentration (micrograms per cubic metre)	Southern Quebec peak (98th percentile) concentration (micrograms per cubic metre)	Southern Ontario peak (98th percentile) concentration (micrograms per cubic metre)	Prairies and northern Ontario peak (98th percentile) concentration (micrograms per cubic metre)	British Columbia peak (98th percentile) concentration (micrograms per cubic metre)	Northern territories peak (98th percentile) concentration (micrograms per cubic metre)
2005	14.8	34.7	32.8	12.3	15.2	11.9
2006	14.0	21.6	23.3	15.4	15.9	5.7
2007	14.8	22.2	27.0	13.6	14.3	12.0
2008	14.2	22.4	20.8	13.7	14.5	15.9
2009	15.0	22.0	14.8	14.4	16.5	16.7
2010	15.3	24.4	20.8	26.3	22.3	10.9
2011	16.1	20.3	17.8	23.5	12.5	16.7
2012	13.1	21.8	16.9	18.8	15.2	14.0
2013	16.9	20.7	19.8	18.6	16.0	20.6
2014	13.9	18.3	20.9	24.0	21.8	70.4
2015	14.0	19.4	20.1	29.4	20.2	21.6
2016	12.0	15.5	16.2	31.4	14.7	14.0
2017	12.4	16.6	16.2	25.9	53.3	17.7
2018	11.1	18.2	18.5	47.3	54.5	11.4
2019	10.9	16.4	17.2	20.6	16.2	18.9
2020 standard	**27**	**27**	**27**	**27**	**27**	**27**
Annual trend	**-0.2**	**-0.6**	**-0.6**	**1.4**	**0.5**	**No trend**

Note: The regional peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 11 monitoring stations in Atlantic Canada, 36 in southern Quebec, 39 in southern Ontario, 33 in the Prairies and northern Ontario region, 25 in British Columbia and 3 in the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.7. Data for Figure 8. Peak fine particulate matter concentrations, selected Canadian urban areas, 2019

Urban area	2005 (micrograms per cubic metre)	2006 (micrograms per cubic metre)	2007 (micrograms per cubic metre)	2008 (micrograms per cubic metre)	2009 (micrograms per cubic metre)	2010 (micrograms per cubic metre)	2011 (micrograms per cubic metre)	2012 (micrograms per cubic metre)
Halifax, NS	14.9	n/a	15.3	13.5	13.9	17.6	15.4	13.9
St. John's, NL	10.1	8.1	7.1	9.0	12.8	12.8	11.5	9.7
Vancouver, BC	14.5	13.3	12.7	12.9	13.7	12.4	10.0	12.2
Fredericton, NB	16.1	15.7	16.8	14.9	n/a	15.0	16.6	15.3
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Regina, SK	12.0	17.0	12.6	10.8	12.0	19.8	16.4	13.9
Ottawa, ON	33.6	19.9	20.4	16.8	13.2	16.0	13.3	14.6
Winnipeg, MB	14.7	14.5	12.0	13.0	12.3	16.4	18.0	19.5
Victoria, BC	13.7	14.9	16.1	12.6	19.5	20.0	21.5	16.2
Oshawa, ON	n/a	24.3	29.1	20.8	14.4	22.5	17.5	15.3
Yellowknife, NT	11.0	4.6	12.8	28.5	11.2	n/a	25.8	15.2
St. Catharines - Niagara Falls, ON	32.6	28.0	32.1	21.7	15.2	23.2	18.5	16.5
Kitchener, ON	34.5	23.3	29.5	22.0	15.2	21.0	17.5	17.2
Montreal, QC	42.3	24.4	24.5	32.5	30.8	30.6	25.8	27.5
London, ON	34.9	24.8	25.3	23.0	16.8	n/a	17.0	16.6
Toronto, ON	34.8	24.4	28.8	22.3	14.6	22.2	18.7	17.7
Calgary, AB	11.9	17.2	15.2	11.5	n/a	30.5	24.0	21.9
Gatineau, QC	37.1	20.9	20.7	n/a	n/a	23.1	20.8	22.5
Saskatoon, SK	8.7	15.1	10.6	10.4	10.3	20.4	14.5	17.4
Quebec, QC	34.1	22.8	23.7	20.5	n/a	27.6	22.9	28.5
Hamilton, ON	33.8	26.1	29.0	24.5	16.0	23.6	20.9	20.6
Barrie, ON	32.7	23.4	28.8	20.3	14.0	19.5	17.5	17.4
Windsor, ON	32.3	24.4	29.4	22.8	18.3	22.8	21.8	19.0
Edmonton, AB	14.6	17.8	14.8	19.4	21.5	44.0	27.6	21.5
Whitehorse, YT	12.8	n/a	n/a	7.6	n/a	6.3	7.5	17.8

Urban area	2013 (micrograms per cubic metre)	2014 (micrograms per cubic metre)	2015 (micrograms per cubic metre)	2016 (micrograms per cubic metre)	2017 (micrograms per cubic metre)	2018 (micrograms per cubic metre)	2019 (micrograms per cubic metre)
Halifax, NS	16.8	11.2	11.3	10.6	12.1	10.6	9.3
St. John's, NL	14.6	15.2	12.4	10.3	11.4	10.3	10.1
Vancouver, BC	14.6	15.9	16.1	11.2	34.8	31.2	13.1
Fredericton, NB	14.9	13.0	16.2	12.0	n/a	13.4	14.1
Charlottetown, PE	n/a	n/a	11.4	n/a	n/a	n/a	14.5
Regina, SK	14.3	18.2	76.8	22.9	21.6	27.7	14.7
Ottawa, ON	21.2	20.1	19.9	16.8	15.4	16.4	15.0
Winnipeg, MB	21.3	18.0	20.6	14.5	16.5	25.6	15.5
Victoria, BC	21.8	18.8	18.4	11.8	24.0	28.7	16.7
Oshawa, ON	20.4	18.9	20.4	16.6	14.6	18.2	17.4
Yellowknife, NT	31.9	130.9	31.6	19.7	19.9	9.4	17.7
St. Catharines - Niagara Falls, ON	19.5	n/a	20.3	15.6	16.2	17.2	18.0
Kitchener, ON	22.5	26.8	23.2	17.8	17.8	20.3	18.1
Montreal, QC	25.8	22.9	23.0	18.2	21.5	21.7	18.4
London, ON	21.9	23.3	21.2	16.2	16.8	19.8	18.7
Toronto, ON	20.7	24.5	22.8	18.9	18.8	20.5	18.9
Calgary, AB	20.8	21.2	28.1	14.7	34.6	54.0	19.2
Gatineau, QC	22.2	18.3	18.3	18.5	n/a	18.4	19.2
Saskatoon, SK	17.3	22.7	36.4	21.4	20.3	57.0	19.3
Quebec, QC	25.7	22.6	25.4	21.4	19.5	22.8	19.7
Hamilton, ON	23.5	24.6	24.0	18.4	19.2	22.1	19.7
Barrie, ON	19.8	21.2	19.3	18.0	18.6	21.0	20.8
Windsor, ON	22.8	24.2	22.4	18.8	18.6	21.7	21.5
Edmonton, AB	26.3	29.5	22.3	20.2	28.6	51.4	24.6
Whitehorse, YT	19.9	n/a	18.3	15.6	21.8	12.8	28.7

Note: n/a = not available. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.8. Data for Figure 10. National average ozone concentrations, Canada, 2005 to 2019

Year	Average concentration (parts per billion)
2005	32.8
2006	32.7
2007	33.0
2008	32.4
2009	32.0
2010	33.2
2011	33.2
2012	33.8
2013	33.2
2014	33.1
2015	33.2
2016	32.5
2017	33.6
2018	34.0
2019	32.9
Annual trend	**No trend**

Note: The national average O_3 concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 171 monitoring stations across Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.9. Data for Figure 11. Regional average ozone concentrations, Canada, 2005 to 2019

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)	Northern territories average concentration (parts per billion)
2005	32.7	33.7	39.1	31.4	25.2	32.0
2006	33.7	31.2	36.4	33.2	28.6	30.3
2007	33.1	32.5	38.8	32.4	25.9	28.0
2008	32.7	31.4	37.5	32.1	26.9	28.0
2009	31.6	30.6	35.4	33.3	27.9	27.0
2010	32.7	33.3	37.6	32.7	27.5	31.0
2011	32.4	32.4	36.5	35.3	27.9	30.3
2012	32.5	33.8	38.0	33.5	29.0	30.7
2013	33.3	34.0	36.6	34.1	26.3	28.7
2014	33.3	33.2	36.6	32.9	28.0	30.0
2015	32.9	33.9	36.8	33.1	27.7	30.7
2016	31.9	33.2	37.3	31.4	26.6	30.7
2017	34.2	33.6	36.4	34.5	28.9	27.7
2018	34.3	34.9	36.7	34.9	28.2	31.0
2019	33.8	33.9	35.9	33.0	26.7	31.5
Annual trend	**No trend**	**0.2**	**No trend**	**No trend**	**No trend**	**No trend**

Note: The regional average O_3 concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 21 monitoring stations in Atlantic Canada, 41 in southern Quebec, 42 in southern Ontario, 34 in the Prairies and northern Ontario region, 30 in British Columbia and 3 in the northern territories region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.10. Data for Figure 12. Average ozone concentrations, selected Canadian urban areas, 2019

Urban area	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)
Winnipeg, MB	27.0	30.5	30.0	30.0	28.0	32.5	33.5	34.0
Vancouver, BC	22.9	26.9	23.8	24.6	25.7	26.7	26.7	27.4
St. John's, NL	33.5	35.0	34.0	34.5	24.5	33.5	33.0	34.5
Victoria, BC	24.0	31.0	n/a	27.0	28.0	26.0	27.0	31.0
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Yellowknife, NT	32.0	31.0	29.0	28.0	27.0	30.0	29.0	31.0
Quebec, QC	30.7	30.0	30.5	29.0	28.8	31.3	29.8	30.7
Edmonton, AB	27.0	30.0	30.3	31.0	31.7	28.0	33.3	31.0
Montreal, QC	31.5	28.5	30.8	29.9	29.0	30.9	30.4	31.6
Fredericton, NB	33.0	35.0	37.0	35.0	33.0	33.0	31.0	32.0
Ottawa, ON	33.0	32.0	35.0	35.0	32.0	34.5	32.5	34.5
Saskatoon, SK	29.0	27.0	26.0	28.0	30.0	30.0	33.0	30.0
Oshawa, ON	n/a	35.0	37.0	35.0	34.0	37.0	36.0	37.0
Toronto, ON	36.6	33.9	36.6	35.1	33.8	35.3	34.2	36.6
Halifax, NS	19.0	28.0	26.0	25.5	28.0	27.0	30.0	28.5
Regina, SK	23.0	22.0	n/a	29.0	30.0	29.0	34.0	28.0
Barrie, ON	38.0	34.0	36.0	37.0	34.0	36.0	35.0	36.0
Calgary, AB	28.0	30.0	30.5	32.5	35.0	31.0	33.5	31.0
Gatineau, QC	34.0	31.0	n/a	32.0	30.0	33.0	33.0	35.0
Hamilton, ON	36.3	35.3	37.7	36.7	34.7	37.3	36.0	37.3
Whitehorse, YT	33.0	n/a	33.0	31.0	n/a	n/a	n/a	34.0
Kitchener, ON	40.0	37.0	40.0	38.0	36.0	38.0	37.0	39.0
Windsor, ON	39.5	36.5	39.5	38.0	36.0	38.5	38.5	40.0
London, ON	37.0	35.0	38.0	37.0	34.0	37.0	36.0	38.0
St. Catharines - Niagara Falls, ON	39.0	37.0	40.0	38.0	35.0	38.0	38.0	39.0

Urban area	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)	2017 (parts per billion)	2018 (parts per billion)	2019 (parts per billion)
Winnipeg, MB	35.0	31.0	29.0	24.5	23.0	30.0	16.0
Vancouver, BC	24.6	26.4	26.0	25.2	26.4	26.3	25.1
St. John's, NL	32.0	33.0	35.0	33.0	34.0	32.0	28.5
Victoria, BC	28.0	31.0	28.5	30.0	31.0	31.5	29.0
Charlottetown, PE	n/a	35.0	43.0	33.0	35.0	33.0	30.0
Yellowknife, NT	29.0	29.0	30.0	30.0	29.0	30.0	31.0
Quebec, QC	32.8	31.3	32.5	31.5	32.3	34.0	32.3
Edmonton, AB	32.3	31.3	31.6	31.1	32.7	34.0	32.4
Montreal, QC	32.1	31.5	32.7	32.5	32.5	33.8	32.7
Fredericton, NB	33.0	33.0	32.0	30.0	n/a	38.0	33.0
Ottawa, ON	34.0	33.5	34.0	34.0	33.5	34.0	33.0
Saskatoon, SK	34.0	32.0	32.0	29.0	34.0	34.0	33.0
Oshawa, ON	36.0	36.0	35.0	36.0	37.0	35.0	33.0
Toronto, ON	34.7	34.9	34.9	35.5	34.2	35.1	33.4
Halifax, NS	31.5	35.0	31.0	29.0	31.7	34.0	33.5
Regina, SK	26.0	33.0	34.0	34.0	35.0	35.0	34.0
Barrie, ON	34.0	34.0	34.0	35.0	35.0	36.0	34.0
Calgary, AB	34.0	33.0	34.3	31.3	37.3	35.0	35.0
Gatineau, QC	33.0	34.0	34.0	34.0	34.0	36.0	35.0
Hamilton, ON	35.5	35.3	36.3	37.3	36.3	36.0	35.3
Whitehorse, YT	n/a	31.0	33.0	30.0	35.0	35.0	36.0
Kitchener, ON	37.0	37.0	38.0	39.0	37.0	36.0	36.0
Windsor, ON	37.5	38.0	38.0	39.5	38.0	37.5	36.5
London, ON	39.0	39.0	39.0	40.0	39.0	37.0	37.0
St. Catharines - Niagara Falls, ON	38.0	38.0	38.0	40.0	37.0	37.0	38.0

Note: n/a = not available. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.11. Data for Figure 14. National peak ozone concentrations, Canada, 2005 to 2019

Year	Peak (4th-highest) 8-hour concentration (parts per billion)
2005	63.1
2006	61.3
2007	64.1
2008	59.8
2009	57.4
2010	59.3
2011	57.0
2012	60.4
2013	56.4
2014	54.3
2015	58.5
2016	56.5
2017	56.9
2018	59.3
2019	53.4
2020 standard	**62**
Annual trend	**-0.5**

Note: The national peak O_3 concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 171 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.12. Data for Figure 15. Regional peak ozone concentrations, Canada, 2005 to 2019

Year	Atlantic Canada peak (4th-highest) 8-hour concentration (parts per billion)	Southern Quebec peak (4th-highest) 8-hour concentration (parts per billion)	Southern Ontario peak (4th-highest) 8-hour concentration (parts per billion)	Prairies and northern Ontario peak (4th-highest) 8-hour concentration (parts per billion)	British Columbia peak (4th-highest) 8-hour concentration (parts per billion)	Northern territories peak (4th-highest) 8-hour concentration (parts per billion)
2005	53.1	67.1	81.7	54.0	49.3	53.3
2006	56.9	61.4	73.9	57.7	52.7	49.9
2007	56.0	67.3	80.0	56.4	50.0	45.4
2008	53.3	59.0	71.6	57.3	51.8	47.4
2009	54.2	55.5	66.3	56.8	51.1	45.0
2010	51.2	60.5	70.3	57.9	49.8	46.5
2011	50.3	55.2	66.7	59.6	47.3	51.0
2012	50.8	60.9	75.4	55.8	50.2	50.1
2013	50.3	57.3	64.7	56.8	47.3	50.1
2014	48.7	53.5	62.5	53.6	48.6	45.7
2015	51.5	59.5	65.9	59.9	50.8	45.7
2016	48.3	57.4	67.4	58.3	44.7	45.2
2017	54.3	56.1	63.9	54.5	53.5	44.8
2018	52.3	58.1	66.5	61.1	54.6	48.7
2019	49.2	52.0	58.6	58.0	46.4	45.9
2020 standard	**62**	**62**	**62**	**62**	**62**	**62**
Annual trend	**-0.4**	**-0.6**	**-1.0**	**No trend**	**No trend**	**No trend**

Note: The regional peak O_3 concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 21 monitoring stations in Atlantic Canada, 41 in southern Quebec, 42 in southern Ontario, 34 in the Prairies and northern Ontario region, 30 in British Columbia and 3 in the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.13. Data for Figure 16. Peak ozone concentrations, selected Canadian urban areas, 2019

Urban area	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)
Winnipeg, MB	52.0	52.0	51.7	50.6	49.8	63.9	53.0	58.8
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vancouver, BC	46.1	50.0	46.8	48.8	47.4	48.1	45.2	45.9
Yellowknife, NT	53.3	52.9	46.4	48.8	42.0	44.3	48.0	50.6
St. John's, NL	49.1	50.1	54.0	49.0	47.2	49.9	49.2	52.0
Victoria, BC	45.3	50.6	n/a	49.9	47.1	43.4	44.5	48.9
Fredericton, NB	52.6	64.6	63.8	58.3	54.1	50.4	48.1	50.1
Halifax, NS	40.3	56.4	45.3	45.9	56.8	45.4	46.4	46.6
Quebec, QC	61.9	59.2	66.6	53.1	53.3	59.1	50.4	55.5
Montreal, QC	66.7	59.6	66.3	58.1	55.8	60.9	55.3	61.9
Ottawa, ON	72.4	67.3	70.3	66.7	59.0	61.9	54.6	65.2
Barrie, ON	77.4	63.9	73.6	75.4	61.4	64.9	58.8	76.6
Whitehorse, YT	47.5	n/a	51.0	50.8	n/a	n/a	n/a	49.6
Saskatoon, SK	50.6	44.8	44.6	45.9	51.6	56.0	58.5	48.0
Oshawa, ON	84.5	70.0	77.6	64.7	63.4	75.5	65.5	71.1
Gatineau, QC	75.9	66.8	68.3	65.0	55.4	63.0	53.6	66.1
Toronto, ON	79.4	72.6	79.5	71.0	67.4	71.0	65.2	74.2
Kitchener, ON	79.4	73.1	77.4	70.9	65.1	66.9	65.6	73.5
Calgary, AB	48.9	53.0	55.3	53.2	59.5	55.0	55.3	53.5
Regina, SK	40.5	38.9	n/a	52.5	51.1	53.8	59.4	47.6
Hamilton, ON	79.7	73.6	78.0	71.7	66.6	69.5	66.7	70.7
St. Catharines - Niagara Falls, ON	82.6	75.0	84.0	70.0	64.5	67.9	68.3	73.3
London, ON	73.4	72.0	74.6	70.6	61.3	68.4	66.6	77.4
Edmonton, AB	50.9	57.6	60.2	58.5	58.7	57.6	59.7	54.0
Windsor, ON	91.1	79.7	92.4	77.7	69.0	73.0	80.6	82.7

Urban area	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)	2017 (parts per billion)	2018 (parts per billion)	2019 (parts per billion)
Winnipeg, MB	55.7	54.3	60.1	44.3	38.5	61.6	38.8
Charlottetown, PE	n/a	53.1	62.1	46.8	48.5	48.0	43.0
Vancouver, BC	45.0	46.0	47.5	42.4	51.1	52.7	43.7
Yellowknife, NT	49.5	44.9	44.4	45.0	45.9	50.0	44.3
St. John's, NL	47.4	45.4	54.3	46.0	47.4	47.6	45.4
Victoria, BC	47.2	47.8	46.6	46.2	48.2	50.1	47.2
Fredericton, NB	50.6	48.4	55.3	45.4	n/a	57.0	47.5
Halifax, NS	46.7	51.3	46.3	45.4	51.0	50.3	48.3
Quebec, QC	56.6	51.0	55.7	52.8	50.1	55.5	49.2
Montreal, QC	55.9	52.2	61.0	58.1	59.0	58.3	50.9
Ottawa, ON	58.5	53.0	61.9	59.5	59.4	58.9	52.1
Barrie, ON	59.9	56.3	63.4	65.3	57.5	64.4	53.1
Whitehorse, YT	n/a	53.1	55.1	47.1	53.1	57.5	53.4
Saskatoon, SK	54.6	50.0	58.1	54.3	55.9	59.1	53.6
Oshawa, ON	63.1	60.6	62.8	67.8	69.9	63.3	54.4
Gatineau, QC	60.1	56.1	63.9	61.6	61.9	61.0	55.0
Toronto, ON	65.1	61.7	66.0	66.6	65.3	65.9	57.0
Kitchener, ON	65.6	64.9	65.1	69.3	64.9	65.9	57.3
Calgary, AB	59.2	53.5	61.7	58.9	57.2	65.9	57.7
Regina, SK	50.9	54.6	62.0	59.1	54.9	58.9	57.8
Hamilton, ON	64.9	61.4	63.5	68.5	65.1	67.5	57.9
St. Catharines - Niagara Falls, ON	65.0	61.8	66.4	67.3	64.9	63.9	58.6
London, ON	68.6	66.6	66.1	70.0	66.4	68.0	59.9
Edmonton, AB	56.7	52.4	62.4	59.5	55.8	66.4	62.9
Windsor, ON	66.7	69.1	69.5	73.8	67.4	76.8	68.1

Note: n/a = not available. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program and the Canadian Air and Precipitation Monitoring Network.

Table A.14. Data for Figure 18. National average nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	Average concentration (parts per billion)
2005	11.7
2006	10.6
2007	10.4
2008	9.8
2009	9.5
2010	8.9
2011	8.7
2012	8.1
2013	8.1
2014	8.1
2015	7.7
2016	7.4
2017	7.5
2018	7.5
2019	7.2
2020 standard	**17.0**
Annual trend	**-0.3**

Note: The national average NO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 119 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.15. Data for Figure 19. Regional average nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2005	5.1	14.5	15.4	8.7	12.7
2006	3.3	12.4	13.1	8.5	12.5
2007	4.0	12.3	11.7	8.5	11.7
2008	4.5	12.7	11.2	7.7	11.5
2009	3.4	11.4	10.1	8.2	11.2
2010	4.1	10.6	9.6	8.2	9.7
2011	4.0	11.6	9.7	7.4	9.5
2012	3.4	9.5	8.6	7.0	9.8
2013	4.3	9.5	8.5	7.3	9.5
2014	3.8	8.9	8.8	7.1	9.4
2015	3.6	8.5	8.5	6.4	9.6
2016	3.1	8.4	8.0	6.4	8.8
2017	3.9	8.4	7.7	6.2	9.6
2018	3.0	8.6	7.4	7.0	9.1
2019	2.9	8.0	7.4	6.6	8.9
2020 standard	**17.0**	**17.0**	**17.0**	**17.0**	**17.0**
Annual trend	**-0.1**	**-0.4**	**-0.4**	**-0.2**	**-0.3**

Note: The regional average NO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 7 monitoring stations in Atlantic Canada, 14 in southern Quebec, 30 in southern Ontario, 37 in the Prairies and northern Ontario region and 29 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.16. Data for Figure 20. Average nitrogen dioxide concentrations, selected Canadian urban areas, 2019

Urban area	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)
St. John's, NL	4.7	4.0	n/a	4.7	2.8	4.3	4.0	3.8
Yellowknife, NT	3.9	3.9	2.8	1.9	2.1	4.7	3.0	2.2
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fredericton, NB	n/a	3.1	3.6	3.3	n/a	2.8	3.4	2.4
Oshawa, ON	n/a	8.9	8.1	n/a	7.4	7.2	7.0	5.6
Halifax, NS	n/a	15.7	n/a	8.7	n/a	12.5	7.0	6.5
Gatineau, QC	10.0	8.2	7.9	8.6	7.9	6.6	6.9	6.1
Whitehorse, YT	3.6	n/a	n/a	n/a	n/a	n/a	n/a	5.9
London, ON	14.1	12.3	11.7	10.8	9.0	8.8	8.3	6.3
Quebec, QC	12.6	n/a	12.4	13.2	11.2	7.9	8.4	9.1
St. Catharines - Niagara Falls, ON	n/a	11.7	12.0	10.4	9.9	9.1	8.5	8.0
Kitchener, ON	12.9	10.8	9.7	9.0	8.6	7.7	7.7	7.1
Victoria, BC	10.4	n/a	n/a	9.9	10.6	9.9	6.8	7.0
Barrie, ON	13.8	12.6	11.4	10.8	9.9	8.7	8.6	8.1
Winnipeg, MB	9.9	10.1	10.4	11.7	11.6	8.1	9.7	7.8
Ottawa, ON	9.8	8.6	8.3	9.8	7.6	6.8	7.3	7.2
Saskatoon, SK	9.9	10.5	n/a	8.5	10.3	11.1	11.4	10.5
Montreal, QC	16.0	13.6	13.5	14.0	12.4	11.1	11.7	10.3
Regina, SK	12.1	14.7	12.0	10.8	10.1	10.9	9.4	9.3
Windsor, ON	17.0	16.5	16.7	15.7	13.8	15.1	13.7	12.3
Hamilton, ON	18.3	16.6	15.0	12.9	12.0	11.3	12.1	10.9
Edmonton, AB	18.9	16.7	16.0	16.0	16.1	15.1	14.1	14.0
Toronto, ON	19.3	17.1	16.5	15.4	14.7	13.6	13.7	12.2
Vancouver, BC	15.0	14.1	13.4	12.9	13.3	10.8	10.6	11.3
Calgary, AB	19.1	19.1	18.2	12.9	17.4	15.9	13.7	12.1

Urban area	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)	2017 (parts per billion)	2018 (parts per billion)	2019 (parts per billion)
St. John's, NL	4.5	3.9	3.2	3.5	4.3	3.4	1.2
Yellowknife, NT	3.2	2.8	3.1	1.9	3.5	2.9	1.3
Charlottetown, PE	n/a	2.0	1.9	1.9	1.8	1.8	2.3
Fredericton, NB	3.4	3.2	3.2	2.4	n/a	1.8	2.5
Oshawa, ON	5.9	6.8	6.6	6.3	6.4	3.8	3.5
Halifax, NS	6.0	1.7	5.8	5.0	4.0	3.4	4.4
Gatineau, QC	6.3	5.6	5.6	5.9	5.5	5.5	5.3
Whitehorse, YT	5.2	n/a	5.3	n/a	n/a	5.7	n/a
London, ON	6.4	6.9	6.6	5.4	5.8	5.4	5.8
Quebec, QC	8.8	9.1	8.7	6.6	7.0	7.0	6.0
St. Catharines - Niagara Falls, ON	7.7	7.3	7.3	6.6	6.6	6.0	6.0
Kitchener, ON	6.7	7.0	6.8	6.2	5.8	5.8	6.2
Victoria, BC	7.2	6.7	8.6	6.7	6.6	6.5	6.3
Barrie, ON	7.8	8.1	7.4	8.1	7.3	6.4	6.3
Winnipeg, MB	7.6	5.9	7.0	8.0	4.7	6.1	6.6
Ottawa, ON	7.3	6.7	6.6	6.3	6.2	7.3	6.7
Saskatoon, SK	11.1	9.7	8.2	8.9	8.6	9.0	8.1
Montreal, QC	10.2	9.4	8.6	9.0	8.7	8.9	8.2
Regina, SK	9.3	11.0	n/a	7.3	8.5	9.1	8.8
Windsor, ON	12.0	12.9	11.8	11.0	10.5	9.9	10.5
Hamilton, ON	11.3	11.3	11.0	10.5	10.0	10.0	10.6
Edmonton, AB	14.7	13.1	13.2	10.6	11.6	12.5	11.1
Toronto, ON	11.9	12.3	11.9	12.0	11.5	11.0	11.1
Vancouver, BC	11.3	11.0	11.1	11.2	12.6	11.4	11.2
Calgary, AB	13.7	15.0	12.0	12.2	12.6	15.8	12.9

Note: n/a = not available. The 2019 concentration presented in the figure for Whitehorse was from 2018. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.17. Data for Figure 22. National peak nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	Peak (98th percentile) 1-hour concentration (parts per billion)
2005	47.9
2006	43.6
2007	43.3
2008	43.5
2009	42.4
2010	40.7
2011	40.2
2012	37.1
2013	38.5
2014	39.7
2015	38.1
2016	36.0
2017	36.5
2018	38.1
2019	37.0
2020 standard	**60**
Annual trend	**-0.7**

Note: The national peak NO_2 concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 120 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

- Table A.18. Data for Since 2005, regional peak NO_2 concentrations remained below the 2020 standard of 60 ppb in all regions; however, with the exception of British Columbia, concentrations at some monitoring stations exceeded the standard in earlier years

Figure 23. Regional peak nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada peak (98th percentile) 1-hour concentration (parts per billion)	Southern Quebec peak (98th percentile) 1-hour concentration (parts per billion)	Southern Ontario peak (98th percentile) 1-hour concentration (parts per billion)	Prairies and northern Ontario peak (98th percentile) 1-hour concentration (parts per billion)	British Columbia peak (98th percentile) 1-hour concentration (parts per billion)
2005	40.0	57.6	59.5	42.7	42.0
2006	38.6	46.4	51.2	41.0	41.2
2007	31.0	50.1	47.4	42.4	38.9
2008	34.8	54.9	48.3	40.8	39.7
2009	31.8	48.6	46.3	41.8	39.7
2010	35.3	44.4	44.0	42.1	35.3
2011	34.3	49.5	44.4	40.1	34.2
2012	30.7	41.2	38.6	37.5	35.6
2013	33.0	42.2	40.8	40.9	33.9
2014	32.3	42.8	45.2	38.9	35.5
2015	34.0	45.0	43.9	35.9	34.3
2016	27.6	41.9	39.1	35.2	33.6
2017	28.6	42.3	37.2	34.7	37.7
2018	29.9	42.8	39.1	39.6	36.1
2019	26.2	42.1	40.8	36.2	35.5
2020 standard	**60**	**60**	**60**	**60**	**60**
Annual trend	**-0.7**	**-0.7**	**-1.0**	**-0.5**	**-0.5**

Note: The regional peak NO_2 concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 8 monitoring stations in Atlantic Canada, 14 in southern Quebec, 30 in southern Ontario, 37 in the Prairies and northern Ontario region and 29 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.19. Data for Figure 24. Peak nitrogen dioxide concentrations, selected Canadian urban areas, 2019

Urban area	2005 (parts per billion)	2006 (parts per billion)	2007 (parts per billion)	2008 (parts per billion)	2009 (parts per billion)	2010 (parts per billion)	2011 (parts per billion)	2012 (parts per billion)
St. John's, NL	32.5	30.5	n/a	29.5	28.5	32.2	30.3	27.5
Oshawa, ON	67.0	37.0	40.0	n/a	35.0	37.0	41.0	26.0
Halifax, NS	68.0	59.0	n/a	33.0	n/a	48.0	28.5	26.5
Yellowknife, NT	34.0	30.0	25.0	27.0	20.0	24.0	32.1	27.3
Fredericton, NB	n/a	30.0	33.0	40.0	n/a	33.0	34.6	31.3
Charlottetown, PE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Winnipeg, MB	44.5	45.5	57.5	50.0	65.0	50.5	53.2	40.2
Victoria, BC	38.0	n/a	n/a	39.0	42.4	37.4	28.6	32.8
St. Catharines - Niagara Falls, ON	n/a	45.0	52.0	46.0	42.0	40.0	38.0	37.0
Whitehorse, YT	25.0	n/a	n/a	n/a	n/a	n/a	n/a	41.1
London, ON	58.0	51.0	45.0	47.0	47.0	42.0	46.0	28.0
Gatineau, QC	50.0	43.0	40.0	45.0	43.0	38.0	38.0	33.0
Quebec, QC	56.0	n/a	54.0	60.0	55.0	38.7	46.3	44.0
Barrie, ON	68.0	58.0	52.0	56.0	47.0	46.0	44.0	39.0
Vancouver, BC	46.0	44.5	42.5	41.2	43.1	37.1	36.3	38.3
Kitchener, ON	60.0	53.0	43.0	45.0	49.0	45.0	42.0	37.0
Ottawa, ON	50.0	39.0	44.0	52.0	42.5	39.5	42.0	41.0
Montreal, QC	60.4	48.5	52.6	57.9	50.1	45.2	49.8	43.2
Regina, SK	54.0	76.0	48.0	52.0	55.0	55.0	42.6	45.2
Hamilton, ON	61.5	56.0	54.3	51.7	48.0	46.0	46.5	42.5
Saskatoon, SK	49.0	44.0	n/a	36.0	49.0	53.0	52.9	47.4
Windsor, ON	57.5	54.0	53.0	52.0	52.0	56.0	55.5	47.0
Toronto, ON	66.5	60.4	57.5	57.0	55.8	52.3	50.9	46.7
Edmonton, AB	62.0	58.3	56.7	55.7	59.0	55.7	51.3	50.7
Calgary, AB	60.0	58.5	58.0	72.0	63.5	62.5	58.0	57.4

Urban area	2013 (parts per billion)	2014 (parts per billion)	2015 (parts per billion)	2016 (parts per billion)	2017 (parts per billion)	2018 (parts per billion)	2019 (parts per billion)
St. John's, NL	34.1	35.3	29.2	27.6	28.3	34.4	21.3
Oshawa, ON	31.2	38.6	37.8	33.9	37.3	23.6	23.2
Halifax, NS	26.7	15.0	28.4	22.7	22.3	21.5	24.8
Yellowknife, NT	29.3	27.6	27.3	25.4	31.2	30.9	25.7
Fredericton, NB	35.8	31.8	36.6	29.0	n/a	32.4	27.3
Charlottetown, PE	n/a	20.5	21.8	25.0	27.9	25.7	29.6
Winnipeg, MB	50.6	39.6	35.0	46.9	27.9	30.7	30.6
Victoria, BC	31.3	32.5	37.3	30.2	34.6	33.0	31.4
St. Catharines - Niagara Falls, ON	39.2	40.7	40.6	36.2	33.9	34.1	35.3
Whitehorse, YT	38.8	n/a	36.4	n/a	n/a	36.2	n/a
London, ON	34.0	40.0	40.0	33.5	30.3	32.0	36.5
Gatineau, QC	37.2	36.3	37.6	43.6	36.9	39.1	37.4
Quebec, QC	41.1	44.2	44.0	40.0	42.1	42.4	37.5
Barrie, ON	39.4	51.5	45.2	48.5	44.0	39.7	39.2
Vancouver, BC	37.0	38.6	37.1	38.5	44.3	39.7	39.3
Kitchener, ON	42.0	42.0	46.3	33.4	31.6	35.1	39.9
Ottawa, ON	41.4	43.2	45.2	37.2	40.7	40.5	42.5
Montreal, QC	44.6	45.4	45.6	42.6	43.5	43.3	43.0
Regina, SK	47.8	61.4	n/a	39.6	44.6	51.3	44.6
Hamilton, ON	46.3	47.1	45.9	43.5	40.3	42.7	45.4
Saskatoon, SK	50.6	47.4	37.4	51.5	41.6	47.1	47.3
Windsor, ON	46.5	52.4	45.9	40.4	40.6	44.2	47.9
Toronto, ON	49.0	53.8	50.5	48.0	43.8	46.4	50.0
Edmonton, AB	59.3	51.7	51.8	45.5	47.5	53.6	52.1
Calgary, AB	57.9	55.1	57.0	54.2	54.8	63.5	57.6

Note: n/a = not available. The 2019 concentration presented in the figure for Whitehorse was from 2018. Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. Refer to the section on data completeness criteria for more information.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.20. Data for Figure 26. National average sulphur dioxide concentrations, Canada, 2005 to 2019

Year	Average concentration (parts per billion)
2005	2.0
2006	1.9
2007	1.8
2008	1.7
2009	1.5
2010	1.2
2011	1.2
2012	1.2
2013	1.2
2014	1.1
2015	0.9
2016	0.9
2017	0.8
2018	0.7
2019	0.7
2020 standard	**5.0**
Annual trend	**-0.1**

Note: The national average SO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 80 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.21. Data for Figure 27. Regional average sulphur dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada average concentration (parts per billion)	Southern Quebec average concentration (parts per billion)	Southern Ontario average concentration (parts per billion)	Prairies and northern Ontario average concentration (parts per billion)	British Columbia average concentration (parts per billion)
2005	2.6	4.1	3.9	1.2	1.4
2006	1.8	3.1	3.7	1.1	2.0
2007	2.4	2.4	3.5	1.2	1.6
2008	1.3	2.4	3.1	1.0	1.8
2009	1.3	1.8	2.3	0.9	1.9
2010	0.7	1.6	2.1	0.7	1.6
2011	0.7	1.5	2.9	0.6	1.4
2012	1.3	1.9	2.2	0.5	1.5
2013	1.0	1.7	2.2	0.6	1.4
2014	1.0	1.6	2.2	0.5	1.2
2015	0.8	1.2	1.9	0.5	1.0
2016	0.8	1.3	1.2	0.5	1.0
2017	0.7	1.2	1.3	0.5	1.0
2018	1.1	1.0	1.4	0.5	0.7
2019	0.9	1.2	1.2	0.5	0.7
2020 standard	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
Annual trend	**-0.1**	**-0.1**	**-0.2**	**-0.1**	**-0.1**

Note: The regional average SO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 4 monitoring stations in Atlantic Canada, 9 in southern Quebec, 10 in southern Ontario, 32 in the Prairies and northern Ontario region and 23 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.22. Data for Figure 29. National peak sulphur dioxide concentrations, Canada, 2005 to 2019

Year	Peak (99th percentile) 1-hour concentration (parts per billion)
2005	56.3
2006	51.1
2007	46.0
2008	44.7
2009	42.2
2010	41.8
2011	28.6
2012	30.8
2013	30.7
2014	26.3
2015	24.1
2016	25.2
2017	24.9
2018	22.8
2019	20.3
2020 standard	**70**
Annual trend	**-2.4**

Note: The national peak SO_2 concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 81 monitoring stations across Canada. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.23. Data for Figure 30. Regional peak sulphur dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada peak (99th percentile) 1-hour concentration (parts per billion)	Southern Quebec peak (99th percentile) 1-hour concentration (parts per billion)	Southern Ontario peak (99th percentile) 1-hour concentration (parts per billion)	Prairies and northern Ontario peak (99th percentile) 1-hour concentration (parts per billion)	British Columbia peak (99th percentile) 1-hour concentration (parts per billion)
2005	79.7	74.8	82.8	57.3	37.1
2006	69.7	71.1	76.9	43.8	43.5
2007	64.6	54.7	63.3	49.2	30.9
2008	36.8	48.6	62.0	45.1	39.7
2009	67.3	48.3	48.9	38.7	40.9
2010	43.9	69.6	49.7	39.4	33.9
2011	20.5	41.5	50.6	18.3	30.9
2012	28.4	50.3	50.2	19.3	32.2
2013	35.1	41.3	53.4	21.4	31.5
2014	36.6	39.4	54.5	17.3	21.3
2015	25.9	34.1	46.9	16.8	22.4
2016	24.6	35.3	40.5	22.5	20.7
2017	18.5	28.8	35.7	22.6	24.8
2018	31.8	29.3	36.8	18.8	19.7
2019	20.8	32.7	32.4	17.5	16.3
2020 standard	**70**	**70**	**70**	**70**	**70**
Annual trend	**-3.7**	**-2.6**	**-2.8**	**-2.6**	**-1.8**

Note: The regional peak SO_2 concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 5 monitoring stations in Atlantic Canada, 9 in southern Quebec, 10 in southern Ontario, 32 in the Prairies and northern Ontario Ontario region and 23 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the 2020 Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. While the standards are usually based on a 3-year average, the indicator is calculated as a 1-year average. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.24. Data for Figure 32. National average volatile organic compound concentrations, Canada, 2005 to 2019

Year	Average concentration (parts per billion carbon)
2005	95.5
2006	103.6
2007	98.7
2008	98.9
2009	101.2
2010	87.7
2011	85.3
2012	72.6
2013	74.0
2014	74.8
2015	74.7
2016	62.4
2017	71.8
2018	61.7
2019	63.6
Annual trend	**-3.2**

Note: The national average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) recorded at 30 monitoring stations across Canada. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Table A.25. Data for Figure 33. Regional average volatile organic compound concentrations, Canada, 2005 to 2019

Year	Atlantic Canada average concentration (parts per billion carbon)	Southern Quebec average concentration (parts per billion carbon)	Southern Ontario average concentration (parts per billion carbon)	Prairies and northern Ontario average concentration (parts per billion carbon)	British Columbia average concentration (parts per billion carbon)
2005	137.3	86.3	55.8	134.3	96.0
2006	153.7	91.5	53.1	134.2	133.9
2007	69.4	91.9	50.6	117.5	164.4
2008	131.1	69.0	39.1	145.4	128.3
2009	127.6	59.1	36.7	117.2	169.3
2010	99.9	63.3	37.1	106.8	149.6
2011	85.8	52.5	22.3	106.7	111.4
2012	117.7	49.3	37.6	105.2	85.3
2013	100.1	47.1	36.9	114.5	102.8
2014	103.0	47.3	37.1	107.4	103.7
2015	97.8	49.8	44.4	101.4	99.0
2016	79.4	42.3	35.8	93.7	79.1
2017	121.8	42.6	30.6	89.3	109.9
2018	57.7	40.1	30.1	99.9	92.1
2019	94.1	36.0	27.3	96.3	89.3
Annual trend	**-3.5**	**-3.3**	**-1.6**	**-2.9**	**-3.5**

Note: The regional average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) recorded at 4 monitoring stations in Atlantic Canada, 5 in southern Quebec, 9 in southern Ontario, 5 in the Prairies and northern Ontario region and 7 in British Columbia. There were not enough stations to report results for the northern territories region. For more information, consult the Air quality indicator definitions in the Methods section.
Source: Environment and Climate Change Canada (2022) National Air Pollution Surveillance Program.

Annex B. Monitoring stations used for the national and regional indicators

Table B.1. Legend for Table B.3. Air quality monitoring stations used in calculation of national and regional indicators

Column	Description
NAPS ID	National Air Pollution Surveillance monitoring station identifier. Please consult the National Air Pollution Surveillance Data Products web page for the location and parameters of the National Air Pollution Surveillance stations.
Location	Location of the monitoring station.
Average fine particulate matter	The station contributes data to the time series trend analysis for annual average fine particulate matter in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak fine particulate matter	The station contributes data to the time series trend analysis for annual peak (98th percentile) 24-hour fine particulate matter in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average ozone	The station contributes data to the time series trend analysis for annual average ozone in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak ozone	The station contributes data to the time series trend analysis for annual peak (4th-highest) 8-hour ozone in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average nitrogen dioxide	The station contributes data to the time series trend analysis for annual average nitrogen dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak nitrogen dioxide	The station contributes data to the time series trend analysis for annual peak (98th percentile) daily maximum 1-hour nitrogen dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average sulphur dioxide	The station contributes data to the time series trend analysis for annual average sulphur dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Peak sulphur dioxide	The station contributes data to the time series trend analysis for annual peak (99th percentile) 1-hour sulphur dioxide in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).
Average volatile organic compounds	The station contributes data to the time series trend analysis for annual average volatile organic compounds in the national indicator and regional indicator of the identified region, unless the cell contains n/a (not available).

Table B.2. Acronyms for Table B.3. Air quality monitoring stations used in calculation of national and regional indicators

Description	Acronym
Atlantic Region regional indicator	ATL
Southern Quebec regional indicator	SQC
Southern Ontario regional indicator	SON
Prairies and northern Ontario regional indicator	PNO
British Columbia regional indicator	BCO
Northern territories regional indicator	TER
Stations only used in calculation of the national indicator	NAT

Table B.3. Air quality monitoring stations used in calculation of national and regional indicators

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
10102	St. John's	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL
10301	Corner Brook	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a	n/a	n/a
10401	Mount Pearl	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL	n/a
10501	Grand Falls - Windsor	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
10601	Happy Valley - Goose Bay	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
10602	Corner Brook	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a	n/a	n/a
30113	Halifax	n/a	n/a	ATL[A]	ATL[A]	n/a	ATL[A]	n/a	n/a	ATL[A]
30118	Halifax	n/a	n/a	ATL[A]	ATL[A]	n/a	ATL[A]	n/a	n/a	ATL[A]
30120	Halifax	ATL	ATL	ATL	ATL	n/a	n/a	n/a	n/a	n/a
30310	Sydney	ATL	ATL	ATL	ATL	n/a	n/a	n/a	ATL	n/a
30501	Kejimkujik	n/a	n/a	ATL[A]	ATL[A]	n/a	n/a	n/a	n/a	n/a
30502	Kejimkujik	n/a	n/a	ATL[A]	ATL[A]	n/a	n/a	n/a	n/a	n/a
30701	Aylesford	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
30901	Pictou	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
31101	Kentville	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
40103	Fredericton	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a	n/a	n/a
40104	Fredericton	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a	n/a	n/a
40203	Saint John	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL	ATL
40206	Saint John	n/a	n/a	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a
40207	Saint John	ATL	ATL	ATL	ATL	n/a	n/a	n/a	n/a	n/a
40208	Saint John	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	ATL
40209	Saint John	n/a	n/a	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	ATL[A]	n/a
40302	Moncton	ATL	ATL	ATL	ATL	ATL	ATL	n/a	n/a	n/a
40701	Norton	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
40901	St. Andrews	ATL	ATL	ATL	ATL	n/a	n/a	n/a	n/a	n/a
41201	Lower Newscastle	n/a	n/a	ATL	ATL	n/a	n/a	n/a	n/a	n/a
41302	Bathurst	ATL	ATL	ATL	ATL	n/a	n/a	n/a	n/a	n/a

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
50103	Montreal	SQC	SQC	SQC	SQC	SQC	SQC	SQC	SQC	SQC
50104	Montreal	n/a	n/a	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]
50105	Montreal	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
50109	Montreal	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
50110	Montreal	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a
50113	Laval	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
50115	Montreal	n/a	n/a	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]
50116	Montreal	n/a	n/a	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a
50119	Longueuil	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
50121	Brossard	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]
50122	Brossard	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]
50126	Montreal	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
50128	Montreal	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
50129	Montreal	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	SQC
50131	Montreal	SQC	SQC	n/a	n/a	n/a	n/a	n/a	n/a	n/a
50134	Montreal	n/a	n/a	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]
50135	Montreal	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a
50136	Montreal	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]	SQC[A]
50138	Montreal	n/a	n/a	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	n/a
50204	Gatineau	SQC	SQC	SQC	SQC	SQC	SQC	SQC	SQC	n/a
50308	Quebec	SQC	SQC	SQC	SQC	SQC	SQC	SQC	SQC	n/a
50310	Quebec	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50311	Quebec	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50404	Sherbrooke	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50504	Saguenay	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
50604	Rouyn-Noranda	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
50801	Trois-Rivieres	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	n/a
50802	Trois-Rivieres	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	n/a
50803	Trois Rivières	SQC[A]	SQC[A]	SQC[A]	SQC[A]	n/a	n/a	SQC[A]	SQC[A]	n/a
50902	Saguenay	n/a	n/a	n/a	n/a	n/a	n/a	SQC	SQC	n/a
51501	St. Zephirin-de-Courval	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52001	Charette	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52201	Saint-Simon	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52301	Saint-Faustin-Lac-Carre	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52401	La Peche	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
52801	Auclair	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53201	La Dore	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53301	Deschambault	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53501	Saint-François-de-l'Île-d'Orléans	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53601	Notre-Dame-du-Rosaire	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
53701	St-Hilaire-de-Dorset	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53801	Tingwick	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
53901	Lac-Edouard	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
54201	Chapais	n/a	n/a	SQC	SQC	n/a	n/a	n/a	n/a	n/a
54401	Saint-Anicet	SQC	SQC	SQC	SQC	n/a	n/a	SQC	SQC	n/a
54901	La Patrie	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
55001	Ferme Neuve	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
55101	Senneterre	SQC	SQC	SQC	SQC	n/a	n/a	n/a	n/a	n/a
55301	Saint-Jean-sur-Richelieu	SQC	SQC	SQC	SQC	SQC	SQC	n/a	n/a	n/a
55501	Frelighsburg	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
55502	Frelighsburg	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
55701	Levis	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
55702	Levis	n/a	n/a	SQC[A]	SQC[A]	n/a	n/a	n/a	n/a	n/a
60104	Ottawa	SON	SON	SON	SON	SON	SON	SON	SON	SON
60106	Ottawa	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
60204	Windsor	SON	SON	SON	SON	SON	SON	SON	SON	n/a
60211	Windsor	SON	SON	SON	SON	SON	SON	SON	SON	SON
60302	Kingston	n/a	n/a	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60303	Kingston	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60304	Kingston	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60410	Toronto	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
60421	Toronto	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60428	Brampton	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60429	Toronto	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60430	Toronto	SON	SON	SON	SON	SON	SON	SON	SON	n/a
60432	Mississauga	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60433	Toronto	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
60434	Mississauga	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60435	Toronto	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60440	Toronto	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60450	Brampton	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
60512	Hamilton	SON	SON	SON	SON	SON	SON	SON	SON	SON
60513	Hamilton	SON[A]	SON[A]	SON[A]	SON[A]	SON	SON	SON	SON	n/a
60521	Hamilton	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
60609	Sudbury	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
60610	Sudbury	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]	SON[A]	n/a
60709	Sault Ste. Marie	SON	SON	SON	SON	SON	SON	SON	SON	n/a
60809	Thunder Bay	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	n/a
60903	London	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]
60904	London	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	SON[A]

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
61004	Sarnia	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]
61009	Sarnia	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]
61104	Peterborough	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
61201	Cornwall	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
61302	St. Catharines	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
61402	Brantford	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
61502	Kitchener	SON	SON	SON	SON	SON	SON	n/a	n/a	SON
61603	Oakville	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
61701	Oshawa	n/a	n/a	SON[A]	SON[A]	n/a	n/a	n/a	n/a	n/a
61702	Oshawa	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
61703	Oshawa	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	SON[A]	n/a	n/a	n/a
61802	Guelph	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
62001	North Bay	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
62501	Tiverton	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
62601	Simcoe	SON	SON	SON	SON	SON	SON	SON	SON	SON
63001	Burlington	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
63201	Stouffville	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON[A]
63301	Dorset	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
63601	Longwoods	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	SON
63701	Grand Bend	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
64001	Exp. Lakes Area	n/a	n/a	PNO	PNO	n/a	n/a	n/a	n/a	n/a
64101	Algoma	n/a	n/a	SON	SON	n/a	n/a	n/a	n/a	n/a
64401	Egbert	n/a	n/a	SON	SON	n/a	n/a	n/a	n/a	n/a
65001	Barrie	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
65101	Newmarket	SON	SON	SON	SON	SON	SON	n/a	n/a	SON[A]
65201	Parry Sound	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
65301	Port Stanley	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
65401	Belleville	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
65801	Chatham	SON	SON	SON	SON	SON	SON	n/a	n/a	n/a
65901	Pickle Lake	n/a	n/a	PNO	PNO	n/a	n/a	n/a	n/a	n/a
66101	Bonner Lake	n/a	n/a	SON	SON	n/a	n/a	n/a	n/a	n/a
66201	Petawawa	SON	SON	SON	SON	n/a	n/a	n/a	n/a	n/a
70118	Winnipeg	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	n/a
70119	Winnipeg	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	PNO
70203	Brandon	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	n/a
70301	Flin Flon	PNO	PNO	n/a	n/a	n/a	n/a	PNO	PNO	n/a
80110	Regina	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]
80111	Regina	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]
80211	Saskatoon	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
80402	Prince Albert	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
90120	Edmonton	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	n/a
90121	Edmonton	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO
90130	Edmonton	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	PNO
90222	Calgary	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	n/a
90227	Calgary	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]
90228	Calgary	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]
90230	Calgary	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a	n/a	PNO[A]
90302	Red Deer	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90402	Medicine Hat	PNO	PNO	PNO	PNO	PNO	PNO	n/a	n/a	n/a
90502	Lethbridge	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90601	Fort Saskatchewan	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90602	Fort Saskatchewan	n/a	n/a	n/a	n/a	PNO	PNO	n/a	n/a	n/a
90603	Fort Saskatchewan	n/a	n/a	n/a	n/a	PNO	PNO	PNO	PNO	n/a
90701	Fort McMurray	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90702	Fort McMurray	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90801	Fort Mackay	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
90802	Fort Mackay	n/a	n/a	n/a	n/a	n/a	n/a	PNO	PNO	n/a
90805	Fort Mackay	n/a	n/a	n/a	n/a	n/a	n/a	PNO	PNO	n/a
90806	Fort Mackay	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91101	Elk Island	PNO	PNO	PNO	PNO	n/a	n/a	n/a	n/a	n/a
91301	Tomahawk	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91401	Violet Grove	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91501	Beaverlodge	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91601	Carrot Creek	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91801	Fort Chipewyan	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
91901	Caroline	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
92001	Grande Prairie	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
92201	Lamont	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
92601	Breton	n/a	n/a	PNO	PNO	PNO	PNO	PNO	PNO	n/a
92801	Drayton Valley	PNO	PNO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
92901	Edson	PNO	PNO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
93001	Evergreen Park	PNO	PNO	n/a	n/a	n/a	n/a	PNO	PNO	n/a
93101	Genesee	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a
93801	Warburg	n/a	n/a	n/a	n/a	PNO	PNO	PNO	PNO	n/a
93901	Thorsby	PNO	PNO	n/a	n/a	PNO	PNO	PNO	PNO	n/a
94001	Debolt	PNO	PNO	n/a	n/a	n/a	n/a	PNO	PNO	n/a
94201	Sunnybrook	n/a	n/a	n/a	n/a	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a
94202	Sunnybrook	n/a	n/a	n/a	n/a	PNO[A]	PNO[A]	PNO[A]	PNO[A]	n/a
94301	Cold Lake	n/a	n/a	n/a	n/a	PNO	PNO	PNO	PNO	n/a
94601	Anzac	PNO	PNO	PNO	PNO	PNO	PNO	PNO	PNO	n/a

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
100110	Metro Vancouver - Burnaby	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100111	Metro Vancouver - Port Moody	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO
100112	Metro Vancouver - Vancouver	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100119	Metro Vancouver - Burnaby	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO
100121	Metro Vancouver - North Vancouver	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100125	Metro Vancouver - Delta	n/a	n/a	BCO	BCO	BCO	BCO	n/a	n/a	n/a
100126	Metro Vancouver - Burnaby	n/a	n/a	BCO	BCO	BCO	BCO	n/a	n/a	n/a
100127	Metro Vancouver - Surrey	n/a	n/a	BCO	BCO	BCO	BCO	n/a	n/a	n/a
100128	Metro Vancouver - Richmond	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100132	Metro Vancouver - North Vancouver	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100133	Metro Vancouver - Burnaby	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	BCO
100134	Metro Vancouver - Richmond	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100135	Metro Vancouver - Coquitlam	n/a	n/a	BCO	BCO	BCO	BCO	n/a	n/a	n/a
100136	Metro Vancouver - Burnaby	n/a	n/a	n/a	n/a	n/a	n/a	BCO	BCO	n/a
100137	Metro Vancouver - Burnaby	n/a	n/a	n/a	n/a	n/a	n/a	BCO	BCO	BCO
100138	Metro Vancouver - West Vancouver	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
100202	Prince George	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO
100304	Victoria	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
100401	Kamloops	BCO[A]	BCO[A]	BCO[A]	BCO[A]	n/a	n/a	BCO[A]	BCO[A]	n/a
100402	Kamloops	BCO[A]	BCO[A]	BCO[A]	BCO[A]	n/a	n/a	BCO[A]	BCO[A]	n/a
100701	Kelowna	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101003	Metro Vancouver - Abbotsford	n/a	n/a	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101004	Metro Vancouver - Abbotsford	BCO[A]	BCO[A]	n/a	n/a	BCO[A]	BCO[A]	n/a	n/a	n/a
101005	Metro Vancouver - Abbotsford	BCO[A]	BCO[A]	n/a	n/a	BCO[A]	BCO[A]	n/a	n/a	n/a
101101	Metro Vancouver - Chilliwack	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO
101202	Metro Vancouver - Pitt Meadows	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a

NAPS ID	Location	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide	Average sulphur dioxide	Peak sulphur dioxide	Average volatile organic compounds
101301	Metro Vancouver - Langley	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
101401	Metro Vancouver - Hope	BCO	BCO	BCO	BCO	BCO	BCO	n/a	n/a	n/a
101501	Metro Vancouver - Maple Ridge	n/a	n/a	BCO	BCO	BCO	BCO	n/a	n/a	n/a
101601	Squamish	n/a	n/a	BCO[A]	BCO[A]	BCO[A]	BCO[A]	BCO[A]	BCO[A]	n/a
101603	Squamish	n/a	n/a	BCO[A]	BCO[A]	BCO[A]	BCO[A]	BCO[A]	BCO[A]	n/a
101701	Quesnel	BCO	BCO	BCO	BCO	BCO	BCO	BCO	BCO	n/a
102001	Saturna	n/a	n/a	BCO	BCO	n/a	n/a	n/a	n/a	BCO
102102	Nanaimo	BCO	BCO	BCO	BCO	BCO	BCO	n/a	n/a	n/a
102201	Trail	n/a	n/a	n/a	n/a	n/a	n/a	BCO	BCO	n/a
102401	Smithers	BCO[A]	BCO[A]	BCO[A]	BCO[A]	n/a	n/a	n/a	n/a	n/a
102402	Smithers	BCO[A]	BCO[A]	BCO[A]	BCO[A]	n/a	n/a	n/a	n/a	n/a
102701	Williams Lake	BCO	BCO	BCO	BCO	BCO	BCO	n/a	n/a	n/a
102801	Campbell River	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
103202	Golden	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
103901	Kitimat	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
104003	Vernon	BCO	BCO	BCO	BCO	BCO	BCO	n/a	n/a	n/a
104301	Taylor	n/a	n/a	n/a	n/a	n/a	n/a	BCO	BCO	n/a
105001	Whistler	BCO	BCO	BCO	BCO	BCO	BCO	n/a	n/a	n/a
105101	Houston	BCO	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
105201	Burns Lake	n/a	BCO	n/a	n/a	n/a	n/a	n/a	n/a	n/a
105301	Langdale	n/a	n/a	n/a	n/a	BCO	BCO	BCO	BCO	n/a
119003	Whitehorse	n/a	TER[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
119004	Whitehorse	n/a	TER[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
129003	Yellowknife	NAT	TER	TER	TER	NAT	NAT	NAT[A]	NAT	n/a
129102	Norman Wells	n/a	n/a	TER	TER	NAT	NAT	NAT	NAT	n/a
129202	Inuvik	NAT[A]	TER[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
129203	Inuvik	NAT[A]	TER[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
129501	Snare Rapids	n/a	n/a	TER	TER	n/a	n/a	n/a	n/a	n/a

Note: n/a = not available. [A] The pollutant concentrations for the station were merged for imputation with concentrations from stations located nearby to satisfy data completeness criteria. See Annex C for details.

Annex C. Monitoring station imputations

Table C.1. Imputations of neighbouring stations for the national and regional average fine particulate matter indicators

NAPS ID	Province or territory	Location
10301, 10602	Newfoundland and Labrador	Corner Brook
40103, 40104	New Brunswick	Fredericton
50105, 50136	Quebec	Montreal
50110, 50135	Quebec	Montreal
50121, 50122	Quebec	Brossard
50801, 50802, 50803	Quebec	Trois-Rivieres
60303, 60304	Ontario	Kingston
60421, 60440	Ontario	Toronto
60428, 60450	Ontario	Brampton
60429, 60435	Ontario	Toronto
60432, 60434	Ontario	Mississauga
60513, 60521	Ontario	Hamilton
60609, 60610	Ontario	Sudbury
60903, 60904	Ontario	London
61004, 61009	Ontario	Sarnia
61702, 61703	Ontario	Oshawa
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary
100402, 100401	British Columbia	Kamloops
101004,101005	British Columbia	Abbotsford
102401, 102402	British Columbia	Smithers
129202[A], 129203[A]	Northwest Territories	Inuvik

Note: [A] The station was selected for the calculation of the indicators at the national level only.

Table C.2. Imputations of neighbouring stations for the national and regional peak (98th percentile) 24-hour fine particulate matter indicators

NAPS ID	Province or territory	Location
10301, 10602	Newfoundland and Labrador	Corner Brook
40103, 40104	New Brunswick	Fredericton
50105, 50136	Quebec	Montreal
50110, 50135	Quebec	Montreal
50121, 50122	Quebec	Brossard
50801, 50802, 50803	Quebec	Trois-Rivieres
60303, 60304	Ontario	Kingston
60421, 60440	Ontario	Toronto
60428, 60450	Ontario	Brampton

NAPS ID	Province or territory	Location
60429, 60435	Ontario	Toronto
60432, 60434	Ontario	Mississauga
60513,60521	Ontario	Hamilton
60609, 60610	Ontario	Sudbury
60903, 60904	Ontario	London
61004, 61009	Ontario	Sarnia
61702, 61703	Ontario	Oshawa
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary
100401, 100402	British Columbia	Kamloops
101004,101005	British Columbia	Abbotsford
102401, 102402	British Columbia	Smithers
119003, 119004	Yukon	Whitehorse
129202, 129203	Northwest Territories	Inuvik

Table C.3. Imputations of neighbouring stations for the national and regional average ground-level ozone indicators

NAPS ID	Province or territory	Location
10301, 10602	Newfoundland and Labrador	Corner Brook
30113, 30118	Nova Scotia	Halifax
30501, 30502	Nova Scotia	Kejimkujik
40103, 40104	New Brunswick	Fredericton
40206, 40209	New Brunswick	Saint John
50104, 50134	Quebec	Montreal
50110, 50135	Quebec	Montreal
50115, 50136	Quebec	Montreal
50116, 50138	Quebec	Montreal
50121, 50122	Quebec	Brossard
50801, 50802, 50803	Quebec	Trois-Rivieres
55501, 55502	Quebec	Frelighsburg
55701, 55702	Quebec	Levis
60302, 60303, 60304	Ontario	Kingston
60421, 60440	Ontario	Toronto
60428, 60450	Ontario	Brampton
60429, 60435	Ontario	Toronto
60432, 60434	Ontario	Mississauga
60513, 60521	Ontario	Hamilton
60609, 60610	Ontario	Sudbury
60903, 60904	Ontario	London

NAPS ID	Province or territory	Location
61004, 61009	Ontario	Sarnia
61701, 61702, 61703	Ontario	Oshawa
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary
100401, 100402	British Columbia	Kamloops
101601, 101603	British Columbia	Squamish
102401, 102402	British Columbia	Smithers

Table C.4. Imputations of neighbouring stations for the national and regional peak (4th-highest) 8-hour ground-level ozone indicators

NAPS ID	Province or territory	Location
10301, 10602	Newfoundland and Labrador	Corner Brook
30113, 30118	Nova Scotia	Halifax
30501, 30502	Nova Scotia	Kejimkujik
40103, 40104	New Brunswick	Fredericton
40206, 40209	New Brunswick	Saint John
50104, 50134	Quebec	Montreal
50110, 50135	Quebec	Montreal
50115, 50136	Quebec	Montreal
50116, 50138	Quebec	Montreal
50121, 50122	Quebec	Brossard
50801, 50802, 50803	Quebec	Trois-Rivieres
55501, 55502	Quebec	Frelighsburg
55701, 55702	Quebec	Levis
60302, 60303, 60304	Ontario	Kingston
60421, 60440	Ontario	Toronto
60428, 60450	Ontario	Brampton
60429, 60435	Ontario	Toronto
60432, 60434	Ontario	Mississauga
60513, 60521	Ontario	Hamilton
60609, 60610	Ontario	Sudbury
60903, 60904	Ontario	London
61004, 61009	Ontario	Sarnia
61701, 61702, 61703	Ontario	Oshawa
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary
100401, 100402	British Columbia	Kamloops
101601, 101603	British Columbia	Squamish
102401, 102402	British Columbia	Smithers

Table C.5. Imputations of neighbouring stations for the national and regional average nitrogen dioxide indicators

NAPS ID	Province or territory	Location
10301, 10602	Newfoundland and Labrador	Corner Brook
40103, 40104	New Brunswick	Fredericton
40206, 40209	New Brunswick	Saint John
50104, 50134	Quebec	Montreal
50110, 50135	Quebec	Montreal
50115, 50136	Quebec	Montreal
50116, 50138	Quebec	Montreal
50121, 50122	Quebec	Brossard
60303, 60304	Ontario	Kingston
60421, 60440	Ontario	Toronto
60428, 60450	Ontario	Brampton
60429, 60435	Ontario	Toronto
60903, 60904	Ontario	London
61004, 61009	Ontario	Sarnia
61702, 61703	Ontario	Oshawa
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary
94201, 94202	Alberta	Sunnybrook
101004, 101005	British Columbia	Abbotsford
101601,101603	British Columbia	Squamish

Table C.6. Imputations of neighbouring stations for the national and regional peak (98th percentile) 1-hour nitrogen dioxide indicators

NAPS ID	Province or territory	Location
10301, 10602	Newfoundland and Labrador	Corner Brook
30113, 30118	Nova Scotia	Halifax
40103, 40104	New Brunswick	Fredericton
40206, 40209	New Brunswick	Saint John
50104, 50134	Quebec	Montreal
50110, 50135	Quebec	Montreal
50115, 50136	Quebec	Montreal
50116, 50138	Quebec	Montreal
50121, 50122	Quebec	Brossard
60303, 60304	Ontario	Kingston
60421, 60440	Ontario	Toronto
60428, 60450	Ontario	Brampton
60429, 60435	Ontario	Toronto
60903, 60904	Ontario	London

NAPS ID	Province or territory	Location
61004, 61009	Ontario	Sarnia
61702, 61703	Ontario	Oshawa
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary
94201, 94202	Alberta	Sunnybrook
101004, 101005	British Columbia	Abbotsford
101601, 101603	British Columbia	Squamish

Table C.7. Imputations of neighbouring stations for the national and regional average sulphur dioxide indicators

NAPS ID	Province or territory	Location
40206, 40209	New Brunswick	Saint John
50115, 50136	Quebec	Montreal
50121, 50122	Quebec	Brossard
50801, 50802, 50803	Quebec	Trois Rivières
60609, 60610	Ontario	Sudbury
61004, 61009	Ontario	Sarnia
80110, 80111	Saskatchewan	Regina
94201, 94202	Alberta	Sunnybrook
100401, 100402	British Columbia	Kamloops
101601, 101603	British Columbia	Squamish

Table C.8. Imputations of neighbouring stations for the national and regional peak (99th percentile) 1-hour sulphur dioxide indicators

NAPS ID	Province or territory	Location
40206, 40209	New Brunswick	Saint John
50115, 50136	Quebec	Montreal
50121, 50122	Quebec	Brossard
50801, 50802, 50803	Quebec	Trois-Rivieres
60609, 60610	Ontario	Sudbury
61004, 61009	Ontario	Sarnia
80110, 80111	Saskatchewan	Regina
94201, 94202	Alberta	Sunnybrook
100401, 100402	British Columbia	Kamloops
101601, 101603	British Columbia	Squamish

Table C.9. Imputations of neighbouring stations for the national and regional average volatile organic compound indicators

NAPS ID	Province or territory	Location
30113, 30118	Nova Scotia	Halifax

NAPS ID	Province or territory	Location
50104, 50134	Quebec	Montreal
50115, 50136	Quebec	Montreal
50121, 50122	Quebec	Brossard
60903, 60904	Ontario	London
61004, 61009	Ontario	Sarnia
63201, 65101	Ontario	Stouffville / Newmarket
80110, 80111	Saskatchewan	Regina
90227, 90228, 90230	Alberta	Calgary

Annex D. Fine particulate matter measurement technological transition

Six (6) types of fine particulate matter ($PM_{2.5}$) monitors are used to measure the 1-hour concentrations of $PM_{2.5}$:

- older technology: Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitor
- current technology: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor
- current technology: Met One BAM-1020 Beta Attenuation Mass monitor
- current technology: Thermo Scientific 5030 or 5030i SHARP (Synchronized Hybrid Ambient Real-time Particulate) monitor
- current Technology: GRIMM Environmental Dust Monitor model EDM 180 and 365
- current technology: Teledyne Advanced Pollution Instrumentation Model T640 PM mass monitor with 640X option

The Thermo Scientific 1400a, Met One BAM-1020, Thermo Scientific SHARP and Teledyne T640 monitors have been approved by the United States Environmental Protection Agency as Class III federal equivalent methods and have been deployed across the National Air Pollution Surveillance network replacing older tapered element oscillating microbalance instruments, which in some circumstances may under report the $PM_{2.5}$ mass concentrations relative to the National Air Pollution Surveillance $PM_{2.5}$ Reference Method. Since 2005, the tapered element oscillating microbalance monitors have gradually been replaced by the federal equivalent methods monitors. The federal equivalent methods monitors measure a portion (semi-volatile) of the $PM_{2.5}$ mass not captured by the older instruments. Because of these measurement differences between the new and the old monitoring equipment, concentrations measured with the new monitors may not be directly comparable with the measurements from years in which older instruments were used.

The following table lists the stations used for the national and regional indicators that are operating with new technologies, along with the type of equipment and the year started.

Table D.1. Stations included in the national and regional indicators that use new monitoring technologies for fine particulate matter

NAPS ID	Province or territory	Location	Monitor, year started
10102	Newfoundland and Labrador	St. John's	TEOM, 2005; BAM35, 2009; T640, 2019
10301	Newfoundland and Labrador	Corner Brook	TEOM, 2005; BAM35, 2010
10401	Newfoundland and Labrador	Mount Pearl	TEOM, 2005; BAM35, 2009
10602	Newfoundland and Labrador	Corner Brook	BAM35, 2009
30120	Nova Scotia	Halifax	TEOM, 2005; TEOM-SES, 2005; BAM35, 2006; T640, 2019
30310	Nova Scotia	Sydney	TEOM, 2005; TEOM-SES, 2005; BAM35, 2010; T640, 2019
40103	New Brunswick	Fredericton	TEOM, 2005; BAM35, 2006
40104	New Brunswick	Fredericton	BAM35, 2017; T640, 2019
40203	New Brunswick	Saint John	TEOM, 2005; BAM35, 2005; T640, 2018
40207	New Brunswick	Saint John	BAM35, 2005; T640, 2019
40302	New Brunswick	Moncton	TEOM, 2005; BAM35, 2007; T640, 2019
40901	New Brunswick	Saint Andrews	TEOM, 2005; BAM35, 2007; T640, 2019
41302	New Brunswick	Bathurst	TEOM, 2005; BAM35, 2007; T640, 2019
50103	Quebec	Montreal	TEOM-SES, 2005; TEOM-FDMS, 2007; SHARP5030, 2016
50105	Quebec	Montreal	TEOM-SES, 2005; TEOM-FDMS, 2007

NAPS ID	Province or territory	Location	Monitor, year started
50109	Quebec	Montreal	TEOM-SES, 2005; TEOM-FDMS, 2008; SHARP5030, 2016
50110	Quebec	Montreal	TEOM-SES, 2005; TEOM-FDMS, 2008
50113	Quebec	Laval	TEOM-SES, 2005; BAM35, 2008; T640, 2018
50119	Quebec	Longueuil	TEOM-SES, 2005; BAM35, 2008; T640, 2018
50121	Quebec	Brossard	TEOM-SES, 2005; BAM35, 2008
50122	Quebec	Brossard	BAM35, 2016; T640, 2018
50126	Quebec	Montreal	TEOM-SES, 2005; TEOM-FDMS, 2008; SHARP5030, 2016
50128	Quebec	Montreal	TEOM-SES, 2005; GRIM, 2013; TEOM-FDMS, 2008; SHARP5030, 2016
50129	Quebec	Montreal	TEOM-SES, 2006; TEOM-FDMS, 2005; BAM35, 2005; SHARP5030, 2014
50131	Quebec	Montreal	TEOM-SES, 2005; GRIM, 2013; TEOM-FDMS, 2007
50135	Quebec	Montreal	TEOM-SES, 2013; TEOM-FDMS, 2013; BAM35, 2013; SHARP5030, 2016
50136	Quebec	Montreal	SHARP5030, 2016
50204	Quebec	Gatineau	TEOM-SES, 2005; BAM35, 2009; T640, 2019
50308	Quebec	Quebec	TEOM-SES, 2005; BAM35, 2009; T640, 2017
50310	Quebec	Quebec	TEOM-SES, 2005; BAM35, 2009; T640, 2018
50311	Quebec	Quebec	BAM35, 2005; T640, 2017
50404	Quebec	Sherbrooke	TEOM-SES, 2005; BAM35, 2008; T640, 2018
50504	Quebec	Saguenay	TEOM-SES, 2005; BAM35, 2009; T640, 2018
50604	Quebec	Rouyn-Noranda	BAM35, 2005; T640, 2019
50801	Quebec	Trois-Rivières	TEOM-SES, 2005; BAM35, 2008
50802	Quebec	Trois-Rivières	BAM35, 2011
50803	Quebec	Trois-Rivières	BAM35, 2014; T640, 2018
51501	Quebec	St. Zephirin-de-Courval	BAM35, 2005; T640, 2019
52001	Quebec	Charette	BAM35, 2005; T640, 2019
52201	Quebec	Saint-Simon	BAM35, 2005
52301	Quebec	Saint-Faustin-Lac-Carré	BAM35, 2005
52401	Quebec	La Pêche	BAM35, 2005; T640, 2019
52801	Quebec	Auclair	BAM35, 2005; T640, 2017
53201	Quebec	La Doré	BAM35, 2005
53301	Quebec	Deschambault	BAM35, 2005; T640, 2017
53601	Quebec	Notre-Dame-du-Rosaire	BAM35, 2005
53701	Quebec	St-Hilaire-de-Dorset	BAM35, 2005; T640, 2018
53801	Quebec	Tingwick	BAM35, 2005; T640, 2019
53901	Quebec	Lac Edouard	BAM35, 2006

NAPS ID	Province or territory	Location	Monitor, year started
54401	Quebec	Saint-Anicet	TEOM, SES, 2005; GRIM, 2008; BAM35, 2006; T640, 2019
54901	Quebec	La Patrie	BAM35, 2005; T640, 2019
55001	Quebec	Ferme Neuve	BAM35, 2005
55101	Quebec	Senneterre	BAM35, 2005; T640, 2019
55301	Quebec	Saint-Jean-sur-Richelieu	TEOM-SES, 2005; BAM35, 2005; T640, 2019
60104	Ontario	Ottawa	TEOM-SES, 2005; SHARP5030, 2013
60106	Ontario	Ottawa	TEOM-SES, 2007; SHARP5030, 2013
60204	Ontario	Windsor	TEOM-SES, 2005; SHARP5030, 2013
60211	Ontario	Windsor	TEOM-SES, 2005; SHARP5030, 2013
60303	Ontario	Kingston	TEOM-SES, 2007; SHARP5030, 2013
60304	Ontario	Kingston	SHARP5030, 2013
60410	Ontario	Toronto	TEOM-SES, 2005; SHARP5030, 2013
60421	Ontario	Toronto	TEOM-SES, 2005; SHARP5030, 2013
60428	Ontario	Brampton	TEOM-SES, 2005; SHARP5030, 2013
60429	Ontario	Toronto	TEOM-SES, 2005
60430	Ontario	Toronto	TEOM-SES, 2005; SHARP5030, 2013
60432	Ontario	Mississauga	TEOM-SES, 2005
60433	Ontario	Toronto	TEOM-SES, 2005; SHARP5030, 2013
60434	Ontario	Mississauga	TEOM-SES, 2008; SHARP5030, 2013
60435	Ontario	Toronto	TEOM-SES, 2010; SHARP5030, 2013
60440	Ontario	Toronto	SHARP5030, 2017
60450	Ontario	Brampton	SHARP5030, 2016
60512	Ontario	Hamilton	TEOM-SES, 2005; SHARP5030, 2013
60513	Ontario	Hamilton	TEOM-SES, 2005; SHARP5030, 2013
60521	Ontario	Hamilton	SHARP5030, 2018
60609	Ontario	Sudbury	TEOM-SES, 2005
60610	Ontario	Sudbury	TEOM, 2013; SHARP5030, 2013
60709	Ontario	Sault Ste. Marie	TEOM-SES, 2005; SHARP5030, 2013
60809	Ontario	Thunder Bay	TEOM-SES, 2005; SHARP5030, 2013
60903	Ontario	London	TEOM-SES, 2005
60904	Ontario	London	TEOM-FDMS, 2013; BAM35, 2013; SHARP5030, 2013
61004	Ontario	Sarnia	TEOM-SES, 2005; SHARP5030, 2013
61009	Ontario	Sarnia	SHARP5030, 2016
61104	Ontario	Peterborough	TEOM-SES, 2005; SHARP5030, 2013
61201	Ontario	Cornwall	TEOM-SES, 2005; SHARP5030, 2013
61302	Ontario	St. Catharines	TEOM-SES, 2005; SHARP5030, 2013
61402	Ontario	Brantford	TEOM-SES, 2005; SHARP5030, 2013

NAPS ID	Province or territory	Location	Monitor, year started
61502	Ontario	Kitchener	TEOM-SES, 2005; SHARP5030, 2013
61603	Ontario	Oakville	TEOM-SES, 2005; SHARP5030, 2013
61702	Ontario	Oshawa	TEOM-SES, 2005; SHARP5030, 2013
61703	Ontario	Oshawa	SHARP5030, 2018
61802	Ontario	Guelph	TEOM-SES, 2005; SHARP5030, 2013
62001	Ontario	North Bay	TEOM-SES, 2005; SHARP5030, 2013
62501	Ontario	Tiverton	TEOM-SES, 2005; SHARP5030, 2013
62601	Ontario	Simcoe	TEOM-SES, 2005; SHARP5030, 2013
63001	Ontario	Burlington	TEOM-SES, 2005; SHARP5030, 2013
63301	Ontario	Dorset	TEOM-SES, 2005; SHARP5030, 2013
63701	Ontario	Grand Bend	TEOM-SES, 2005; SHARP5030, 2013
65001	Ontario	Barrie	TEOM-SES, 2005; SHARP5030, 2013
65101	Ontario	Newmarket	TEOM-SES, 2005; SHARP5030, 2013
65201	Ontario	Parry Sound	TEOM-SES, 2005; SHARP5030, 2013
65301	Ontario	Port Stanley	TEOM-SES, 2005; SHARP5030, 2013
65401	Ontario	Belleville	TEOM-SES, 2005; SHARP5030, 2013
65801	Ontario	Chatham	TEOM-SES, 2005; SHARP5030, 2013
66201	Ontario	Petawawa	TEOM-SES, 2007; SHARP5030, 2013
70118	Manitoba	Winnipeg	TEOM, 2005; SHARP5030, 2011
70119	Manitoba	Winnipeg	TEOM, 2005; TEOM-SES, 2013; SHARP5030, 2011
70203	Manitoba	Brandon	TEOM, 2005; SHARP5030, 2011
70301	Manitoba	Flin Flon	TEOM, 2005; SHARP5030, 2011
80110	Saskatchewan	Regina	TEOM, 2005; BAM35, 2009
80111	Saskatchewan	Regina	BAM35, 2011; T640, 2019
80211	Saskatchewan	Saskatoon	TEOM, 2005; BAM35, 2009; T640, 2018
90120	Alberta	Edmonton	TEOM, 2009; TEOM-SES, 2005; TEOM-FDMS, 2010; BAM35, 2016; SHARP5030, 2016
90121	Alberta	Edmonton	TEOM, 2009; TEOM-SES, 2005; TEOM-FDMS, 2010; SHARP5030, 2015
90130	Alberta	Edmonton	TEOM, 2009; TEOM-SES, 2005; TEOM-FDMS, 2010
90222	Alberta	Calgary	TEOM, 2009; TEOM-SES, 2005; TEOM-FDMS, 2010; SHARP5030, 2015
90227	Alberta	Calgary	TEOM-SES, 2005
90228	Alberta	Calgary	TEOM, 2008; TEOM-FDMS, 2010; BAM35, 2012
90230	Alberta	Calgary	BAM35, 2015; SHARP5030, 2015
90302	Alberta	Red Deer	TEOM, 2005; TEOM-FDMS, 2010; SHARP5030, 2013

NAPS ID	Province or territory	Location	Monitor, year started
90402	Alberta	Medicine Hat	TEOM, 2005; TEOM-FDMS, 2010; SHARP5030, 2013
90502	Alberta	Lethbridge	TEOM, 2009; TEOM-SES, 2005; TEOM-FDMS, 2012; SHARP5030, 2016
90601	Alberta	Fort Saskatchewan	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2013
90701	Alberta	Fort McMurray	TEOM, 2005; TEOM-SES, 2010; TEOM-FDMS, 2011; SHARP5030, 2011
90702	Alberta	Fort McMurray	TEOM, 2005; TEOM-SES, 2012; SHARP5030, 2013; T640, 2019
90801	Alberta	Fort Mackay	TEOM, 2005; TEOM-SES, 2010; TEOM-FDMS, 2011; SHARP5030, 2011; T640, 2019
90806	Alberta	Fort Mackay	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2012
91101	Alberta	Elk Island	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2013
91301	Alberta	Tomahawk	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2015
91501	Alberta	Beaverlodge	TEOM, 2005; TEOM-SES, 2014; TEOM-FDMS, 2010; SHARP5030, 2019
91801	Alberta	Fort Chipewyan	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2013
92001	Alberta	Grande Prairie	TEOM, 2005; TEOM-SES, 2010; TEOM-FDMS, 2010; SHARP5030, 2012
92201	Alberta	Lamont	TEOM, 2009; BAM35, 2006; SHARP5030, 2016
92801	Alberta	Drayton Valley	TEOM, 2005; TEOM-SES, 2010; TEOM-FDMS, 2012; SHARP5030, 2015
92901	Alberta	Edson	TEOM, 2005; TEOM-SES, 2011; TEOM-FDMS, 2019
93001	Alberta	Evergreen Park	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2015
93101	Alberta	Genesee	TEOM, 2005; TEOM-SES, 2011; SHARP5030, 2017
93901	Alberta	Thorsby	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2019
94001	Alberta	Debolt	TEOM, 2005; TEOM-SES, 2010; SHARP5030, 2015
94601	Alberta	Anzac	TEOM-SES, 2006; SHARP5030, 2011
100110	British Columbia	Burnaby	TEOM-SES, 2005; SHARP5030, 2013
100111	British Columbia	Port Moody	TEOM-SES, 2005; SHARP5030, 2013
100119	British Columbia	Burnaby	TEOM-SES, 2005; SHARP5030, 2013
100134	British Columbia	Richmond	TEOM-SES, 2005; SHARP5030, 2013
100138	British Columbia	Vancouver	TEOM-SES, 2005; SHARP5030, 2013

NAPS ID	Province or territory	Location	Monitor, year started
100202	British Columbia	Prince George	TEOM, 2005; SHARP5030, 2014
100304	British Columbia	Victoria	TEOM, 2005; BAM35, 2009
100401	British Columbia	Kamloops	BAM35, 2010; SHARP5030, 2017
100402	British Columbia	Kamloops	TEOM, 2005
100701	British Columbia	Kelowna	TEOM, 2005; SHARP5030, 2014
101004	British Columbia	Abbotsford	TEOM-SES-2005
101005	British Columbia	Abbotsford	SHARP5030-2012
101101	British Columbia	Chilliwack	TEOM-SES, 2005; SHARP5030, 2013
101202	British Columbia	Pitt Meadows	TEOM-SES, 2005; SHARP5030, 2013
101301	British Columbia	Langley	TEOM, 2014; TEOM-SES, 2005; SHARP5030, 2013
101401	British Columbia	Hope	TEOM-SES, 2005; SHARP5030, 2013
101701	British Columbia	Quesnel	TEOM, 2005; SHARP5030, 2014
102102	British Columbia	Nanaimo	TEOM, 2005; BAM35, 2014
102401	British Columbia	Smithers	TEOM, 2005; BAM35, 2013; SHARP5030, 2014
102402	British Columbia	Smithers	SHARP5030, 2019
102701	British Columbia	Williams Lake	TEOM, 2005; SHARP5030, 2014
102801	British Columbia	Campbell River	TEOM, 2006; BAM35, 2014
103202	British Columbia	Golden	TEOM, 2005; SHARP5030, 2014
103901	British Columbia	Kitimat	TEOM, 2005; BAM35, 2014
104003	British Columbia	Vernon	TEOM, 2005; SHARP5030, 2014
105001	British Columbia	Whistler	TEOM, 2005; BAM35, 2013
105101	British Columbia	Houston	TEOM, 2005; SHARP5030, 2014
105201	British Columbia	Burns Lake	TEOM, 2006; SHARP5030, 2014
119003	Yukon	Whitehorse	TEOM, 2005
119004	Yukon	Whitehorse	BAM35, 2015; SHARP5030, 2012; T640, 2019
129003	Northwest territories	Yellowknife	BAM35, 2005
129202	Northwest territories	Inuvik	BAM35, 2006
129203	Northwest territories	Inuvik	BAM35, 2011

Annex E. Volatile organic compounds targeted for quantification

Table E.1. Volatile organic compounds targeted for quantification

Compound	CAS registry number
1,2,3-Trimethylbenzene	526-73-8
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
1,3-Butadiene	106-99-0
1,3-Diethylbenzene	141-93-5
1,4-Diethylbenzene	105-05-5
1-Butene/Isobutene	115-11-7/115-11-7
1-Heptene	592-76-7
1-Hexene/2-Methyl-1-Pentene	592-41-6/763-29-1
1-Pentene	109-67-1
2,2,4-Trimethylpentane	540-84-1
2,2-Dimethylbutane	75-83-2
2,3,4-Trimethylpentane	565-75-3
2,3-Dimethylbutane	79-29-8
2,3-Dimethylpentane	565-59-3
2,4-Dimethylhexane	589-43-5
2,4-Dimethylpentane	108-08-7
2,5-Dimethylhexane	592-13-2
2-Ethyltoluene	611-14-3
2-Methyl-2-butene	513-35-9
2-Methylheptane	592-27-8
2-Methylhexane	591-76-4
2-Methylpentane	107-83-5
3-Ethyltoluene	620-14-4
3-Methyl-1-Butene	563-45-1
3-Methylheptane	589-81-1
3-Methylhexane	589-34-4
3-Methylpentane	96-14-0
4-Ethyltoluene	622-96-8
4-Methylheptane	589-53-7
Acetylene	74-86-2
a-Pinene	80-56-8
Benzene	71-43-2
b-Pinene	127-91-3
Butane	106-97-8
Camphene	79-92-5

Compound	CAS registry number
cis-1,2-Dimethylcyclohexane	2207-01-4
cis-2-Butene	590-18-1
cis-2-Hexene	7688-21-3
cis-2-Pentene	627-20-3
cis-3-Methyl-2-pentene	922-61-2
Cyclohexane	110-82-7
Cyclopentane	287-92-3
Decane	124-18-5
d-Limonene	5989-27-5
Dodecane	112-40-3
Ethane	74-84-0
Ethylbenzene	100-41-4
Ethylene	74-85-1
Heptane	142-82-5
Hexane	110-54-3
Indane	496-11-7
Isobutane	75-28-5
Isopentane	78-78-4
Isoprene	78-79-5
iso-Propylbenzene	98-82-8
m and p-Xylene	108-38-3
Methylcyclohexane	108-87-2
Methylcyclopentane	96-37-7
Naphthalene	91-20-3
Nonane	111-84-2
n-Propylbenzene	103-65-1
Octane	111-65-9
o-Xylene	95-47-6
p-Cymene	99-87-6
Pentane	109-66-0
Propane	74-98-6
Propylene	115-07-1
Styrene	100-42-5
Toluene	108-88-3
trans-2-Butene	624-64-6
trans-2-Hexene	4050-45-7
trans-2-Octene	13389-42-9
trans-2-Pentene	646-04-8

Compound	CAS registry number
trans-3-Methyl-2-pentene	616-12-6
trans-4-Methyl-2-pentene	674-76-0
Undecane	1120-21-4

Annex F. Percentiles of the national and regional indicators

Table F.1. Percentiles for Figure 2. National average fine particulate matter concentrations, Canada, 2005 to 2019

Year	10th percentile (micrograms per cubic metre)	90th percentile (micrograms per cubic metre)
2005	3.6	10
2006	4.0	8.1
2007	3.6	8.3
2008	3.9	8.5
2009	3.8	8.4
2010	3.9	10.1
2011	3.7	9.6
2012	3.9	9.4
2013	4.4	9.2
2014	5.1	9.5
2015	4.9	9.3
2016	4.1	8.2
2017	4.5	8.5
2018	4.9	10.7
2019	4.4	7.8

Note: The national average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations for $PM_{2.5}$ recorded at 145 monitoring stations across Canada.

Table F.2. Percentiles for Figure 3. Regional average fine particulate matter concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (micrograms per cubic metre)	Atlantic Canada 90th percentile (micrograms per cubic metre)	Southern Quebec 10th percentile (micrograms per cubic metre)	Southern Quebec 90th percentile (micrograms per cubic metre)	Southern Ontario 10th percentile (micrograms per cubic metre)	Southern Ontario 90th percentile (micrograms per cubic metre)	Prairies and northern Ontario 10th percentile (micrograms per cubic metre)	Prairies and northern Ontario 90th percentile (micrograms per cubic metre)	British Columbia 10th percentile (micrograms per cubic metre)	British Columbia 90th percentile (micrograms per cubic metre)
2005	2.7	7.2	6.1	11.0	5.8	10.4	3.3	5.3	4.4	7.1
2006	3.0	8.7	4.8	8.5	5.2	8.8	4.0	5.8	3.7	6.9
2007	2.8	6.8	4.9	8.6	5.0	9.1	3.4	5.6	3.4	6.5

Year	Atlantic Canada 10th percentile (micrograms per cubic metre)	Atlantic Canada 90th percentile (micrograms per cubic metre)	Southern Quebec 10th percentile (micrograms per cubic metre)	Southern Quebec 90th percentile (micrograms per cubic metre)	Southern Ontario 10th percentile (micrograms per cubic metre)	Southern Ontario 90th percentile (micrograms per cubic metre)	Prairies and northern Ontario 10th percentile (micrograms per cubic metre)	Prairies and northern Ontario 90th percentile (micrograms per cubic metre)	British Columbia 10th percentile (micrograms per cubic metre)	British Columbia 90th percentile (micrograms per cubic metre)
2008	3.3	6.3	4.3	12.7	4.4	8.3	3.4	6.4	4.0	6.5
2009	2.7	6.9	3.6	12.4	3.8	6.7	3.7	7.7	3.9	6.7
2010	2.8	7.2	4.7	11.4	4.0	7.7	4.7	14.5	3.4	8.8
2011	5.1	8.5	4.0	10.5	4.2	7.7	3.6	10.4	3.3	6.5
2012	3.9	6.6	3.9	11.8	4.1	7.4	4.1	9.4	3.3	7.1
2013	4.5	7.0	4.6	10.6	5.6	9.2	3.8	8.7	3.9	8.9
2014	5.2	7.3	4.9	9.6	5.8	9.8	4.6	9.0	5.2	9.1
2015	3.9	7.6	5.0	9.3	5.7	9.4	4.1	10.3	5.0	9.4
2016	4.1	7.9	4.0	8.4	4.8	8.1	4.0	9.5	3.9	8.4
2017	3.9	7.1	4.3	8.5	4.6	7.8	4.5	8.2	5.9	14.2
2018	4.3	5.8	4.3	8.8	5.4	8.2	6.1	11.6	5.4	15.4
2019	4.4	5.5	4.5	7.7	4.5	7.8	4.6	7.8	4.5	8.6

Note: The regional average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 11 monitoring stations in Atlantic Canada, 36 in southern Quebec, 39 in southern Ontario, 33 in the Prairies and northern Ontario region and 24 in British Columbia.

Table F.3. Percentiles for Figure 6. National peak fine particulate matter concentrations, Canada, 2005 to 2019

Year	10th percentile (micrograms per cubic metre)	90th percentile (micrograms per cubic metre)
2005	10.4	38.8
2006	12.3	25.2
2007	11.2	28.9
2008	11.1	25.8
2009	11.5	24.7
2010	12.6	33.2
2011	10.7	26.4
2012	11.3	27.0
2013	13.1	25.0

Year	10th percentile (micrograms per cubic metre)	90th percentile (micrograms per cubic metre)
2014	13.0	29.1
2015	13.7	29.3
2016	10.1	22.2
2017	11.5	39.4
2018	12.4	60.5
2019	10.5	23.4

Note: The national peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 147 monitoring stations across Canada.

Table F.4. Percentiles for Figure 7. Regional peak fine particulate matter concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (micrograms per cubic metre)	Atlantic Canada 90th percentile (micrograms per cubic metre)	Southern Quebec 10th percentile (micrograms per cubic metre)	Southern Quebec 90th percentile (micrograms per cubic metre)	Southern Ontario 10th percentile (micrograms per cubic metre)	Southern Ontario 90th percentile (micrograms per cubic metre)	Prairies and northern Ontario 10th percentile (micrograms per cubic metre)	Prairies and northern Ontario 90th percentile (micrograms per cubic metre)	British Columbia 10th percentile (micrograms per cubic metre)	British Columbia 90th percentile (micrograms per cubic metre)	Northern territories 10th percentile (micrograms per cubic metre)	Northern territories 90th percentile (micrograms per cubic metre)
2005	9.3	25.1	25.3	44.6	29.9	36.1	8.8	16.1	11.0	21.5	11.0	12.8
2006	7.2	23.4	16.4	26.1	18.7	28.0	13.1	18.3	11.1	21.6	4.6	6.7
2007	7.1	26.1	16.6	26.5	20.4	31.1	10.6	16.4	9.4	20.6	11.2	12.8
2008	9.0	19.0	14.0	32.6	16.5	24.1	10.0	20.0	11.0	21.3	7.6	28.5
2009	8.7	17.4	11.5	33.0	11.3	17.5	11.5	17.6	12.0	22.9	11.2	22.2
2010	11.1	22.0	17.6	32.0	13.6	25.0	14.6	42.4	10.2	50.7	6.3	15.4
2011	11.7	18.8	12.2	26.7	12.8	22.8	11.4	49.3	7.7	18.0	7.5	25.8
2012	10.0	15.3	12.0	29.8	13.3	20.6	12.1	23.5	10.2	19.9	8.9	17.8
2013	14.9	19.0	13.2	27.3	15.0	22.9	12.5	26.5	10.2	22.8	10.1	31.9
2014	12.5	16.5	12.0	23.7	14.0	25.5	15.3	33.7	15.3	31.5	9.8	130.9
2015	9.8	19.9	13.0	24.7	14.3	24.4	14.7	46.2	13.7	28.9	15.0	31.6
2016	9.7	18.8	9.9	21.2	12.3	19.7	11.4	33.1	9.7	21.8	6.8	19.7
2017	10.1	15.7	10.5	22.7	12.1	19.3	14.9	34.3	23.5	86.6	11.4	21.8
2018	8.9	13.4	12.1	23.5	14.0	21.2	27.7	64.2	25.1	117.2	9.4	12.8

Year	Atlantic Canada 10th percentile (micrograms per cubic metre)	Atlantic Canada 90th percentile (micrograms per cubic metre)	Southern Quebec 10th percentile (micrograms per cubic metre)	Southern Quebec 90th percentile (micrograms per cubic metre)	Southern Ontario 10th percentile (micrograms per cubic metre)	Southern Ontario 90th percentile (micrograms per cubic metre)	Prairies and northern Ontario 10th percentile (micrograms per cubic metre)	Prairies and northern Ontario 90th percentile (micrograms per cubic metre)	British Columbia 10th percentile (micrograms per cubic metre)	British Columbia 90th percentile (micrograms per cubic metre)	Northern territories 10th percentile (micrograms per cubic metre)	Northern territories 90th percentile (micrograms per cubic metre)
2019	9.3	12.3	11.8	20.4	12.5	20.8	13.9	27.7	9.9	23.1	10.3	28.7

Note: The regional peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 11 monitoring stations in Atlantic Canada, 36 in southern Quebec, 39 in southern Ontario, 33 in the Prairies and northern Ontario region, 25 in British Columbia and 3 in the northern territories region.

Table F.5. Percentiles for Figure 10. National average ozone concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2005	24	40
2006	26	39
2007	26	40
2008	27	39
2009	26	37
2010	27	39
2011	28	39
2012	28	39
2013	26	38
2014	28	38
2015	27	38
2016	26	39
2017	29	38
2018	29	38
2019	27	37

Note: The national average O_3 concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 171 monitoring stations across Canada.

Table F.6. Percentiles for Figure 11. Regional average ozone concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)	Northern territories 10th percentile (parts per billion)	Northern territories 90th percentile (parts per billion)
2005	29	39	30	37	34	44	23	38	21	30	32	32
2006	28	38	28	35	33	40	25	39	24	33	27	33
2007	27	37	29	36	35	43	26	39	21	31	27	29
2008	30	36	29	36	33	41	27	39	23	32	28	28
2009	28	35	26	34	32	39	27	40	24	33	27	27
2010	30	35	29	37	34	41	29	37	25	32	29	34
2011	30	36	29	36	33	39	31	40	24	33	29	33
2012	29	35	30	37	35	41	28	39	25	34	28	33
2013	28	37	32	36	34	39	29	39	22	32	25	32
2014	29	36	30	36	33	40	28	37	24	32	28	33
2015	28	36	31	37	34	40	27	37	23	32	29	33
2016	30	34	31	35	34	40	27	35	23	31	28	34
2017	31	37	31	36	33	39	31	38	24	34	20	34
2018	31	37	32	37	34	39	30	38	24	32	30	32
2019	30	37	32	36	33	38	29	36	22	32	31	32

Note: The regional average O_3 concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 21 monitoring stations in Atlantic Canada, 41 in southern Quebec, 42 in southern Ontario, 34 in the Prairies and northern Ontario region, 30 in British Columbia and 3 in the northern territories region.

Table F.7. Percentiles for Figure 14. National peak ozone concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2005	46	82
2006	49	74
2007	48	82
2008	49	73

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2009	49	68
2010	48	71
2011	47	68
2012	48	77
2013	47	66
2014	46	64
2015	49	67
2016	43	69
2017	47	67
2018	49	68
2019	46	62

Note: The national peak O_3 concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 171 monitoring stations across Canada.

Table F.8. Percentiles for Figure 15. Regional peak ozone concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)	Northern territories 10th percentile (parts per billion)	Northern territories 90th percentile (parts per billion)
2005	46	64	61	75	73	92	46	61	42	60	53	53
2006	48	65	57	68	67	81	49	67	43	65	46	53
2007	47	64	63	72	72	91	49	66	42	59	44	46
2008	46	59	53	66	65	77	49	65	46	59	46	49
2009	48	61	51	59	61	71	50	64	44	61	42	48
2010	45	59	54	65	64	78	52	65	43	57	44	48
2011	47	55	50	60	59	78	54	65	41	53	48	54
2012	44	58	55	67	67	82	49	61	42	58	48	52
2013	43	55	54	60	60	68	52	62	43	54	49	52

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)	Northern territories 10th percentile (parts per billion)	Northern territories 90th percentile (parts per billion)
2014	45	51	50	57	56	69	50	59	41	54	44	48
2015	43	58	55	64	63	70	53	66	45	58	44	48
2016	43	53	53	62	61	73	52	62	39	50	44	47
2017	45	67	50	62	56	68	51	58	43	66	37	51
2018	47	59	54	63	60	73	55	67	45	68	47	50
2019	46	52	50	55	52	68	53	65	41	52	44	48

Note: The regional peak O_3 concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 21 monitoring stations in Atlantic Canada, 41 in southern Quebec, 42 in southern Ontario, 34 in the Prairies and northern Ontario region, 30 in British Columbia and 3 in the northern territories region.

Table F.9. Percentiles for Figure 18. National average nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2005	4.5	19.7
2006	3.9	17.4
2007	4.3	17.0
2008	4.0	16.0
2009	3.6	15.1
2010	4.3	14.3
2011	3.8	14.0
2012	3.5	13.5
2013	3.5	13.6
2014	3.5	14.0
2015	3.4	12.6
2016	3.5	12.0
2017	2.8	13.3
2018	3.1	11.8

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2019	3.1	12.1

Note: The national average NO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 119 monitoring stations across Canada.

Table F.10. Percentiles for Figure 19. Regional average nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2005	2.4	9.3	6.5	24.3	8.5	20.6	4.1	14.3	8.5	18.1
2006	1.6	6.3	5.0	21.4	7.7	19.1	3.2	14.7	8.5	17.0
2007	1.9	6.5	4.8	20.8	5.7	18.2	3.7	13.4	7.9	16.1
2008	1.8	7.5	8.0	19.3	5.5	17.0	3.6	13.1	7.9	15.2
2009	1.0	5.1	7.2	18.4	5.6	15.8	3.5	13.4	6.6	15.5
2010	1.7	6.9	6.8	12.7	5.0	16.1	3.7	13.1	6.7	13.4
2011	1.7	6.2	7.4	17.5	4.6	15.4	2.9	11.8	6.3	13.3
2012	1.5	6.0	6.1	15.9	4.0	14.0	3.0	11.7	6.1	14.0
2013	1.8	7.2	6.3	15.6	4.7	13.6	2.9	11.7	5.3	14.4
2014	1.5	6.2	5.5	15.2	4.5	14.2	2.9	11.8	5.8	14.0
2015	1.5	5.6	5.3	15.2	4.8	13.9	2.6	10.5	5.9	13.8
2016	1.5	5.4	5.2	11.6	4.4	13.3	3.2	9.7	5.5	12.4
2017	1.6	6.9	5.5	11.6	4.4	13.0	2.2	10.7	5.5	14.1
2018	1.5	5.3	5.5	11.4	3.8	11.8	2.9	11.8	4.3	12.9
2019	1.2	3.9	5.0	11.2	3.9	12.5	2.5	11.0	5.2	13.6

Note: The regional average NO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 7 monitoring stations in Atlantic Canada, 14 in southern Quebec, 30 in southern Ontario, 37 in the Prairies and northern Ontario region and 29 in British Columbia.

Table F.11. Percentiles for Figure 22. National peak nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2005	28.0	66.0

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2006	27.0	59.0
2007	28.0	58.0
2008	28.0	59.0
2009	26.0	56.0
2010	28.2	55.0
2011	25.0	53.0
2012	25.0	47.4
2013	24.9	50.6
2014	25.6	53.7
2015	23.2	49.6
2016	24.0	47.4
2017	20.8	48.4
2018	23.3	51.3
2019	21.9	49.1

Note: The national peak NO_2 concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 120 monitoring stations across Canada.

- Table F.12. Percentiles for Since 2005, regional peak NO_2 concentrations remained below the 2020 standard of 60 ppb in all regions; however, with the exception of British Columbia, concentrations at some monitoring stations exceeded the standard in earlier years

Figure 23. Regional peak nitrogen dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2005	27.0	68.0	50.0	66.0	50.0	68.0	26.0	62.0	34.0	51.0
2006	24.0	66.0	38.0	56.0	37.0	63.0	26.0	60.0	32.0	49.0
2007	22.0	38.0	38.0	65.0	34.0	58.0	28.0	60.0	31.0	47.0
2008	20.0	40.0	42.0	65.0	34.0	59.0	27.0	56.0	31.0	47.0
2009	18.0	39.0	38.0	58.0	35.0	55.0	26.0	58.0	30.0	49.0
2010	24.0	48.0	41.0	47.0	31.0	56.0	29.0	55.0	27.8	41.0

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2011	21.6	49.4	42.0	55.0	36.0	56.0	24.0	53.0	24.8	42.3
2012	15.9	42.0	33.0	48.0	26.0	49.0	25.7	51.5	24.5	43.5
2013	23.9	44.3	37.2	49.0	29.2	49.0	25.5	55.5	24.4	43.2
2014	22.8	38.7	36.3	53.7	36.6	57.1	24.0	55.8	25.2	46.2
2015	20.3	49.4	37.6	52.5	37.1	54.7	21.6	52.3	25.1	42.4
2016	19.9	34.3	36.4	47.3	27.0	52.6	23.0	50.2	22.8	43.7
2017	20.8	35.7	36.9	48.8	28.3	45.4	16.0	49.9	26.2	49.9
2018	20.8	38.2	39.1	48.7	29.0	46.9	19.7	59.1	25.6	46.8
2019	21.2	32.0	37.4	47.9	30.4	51.8	19.0	53.9	23.8	43.8

Note: The regional peak NO_2 concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 8 monitoring stations in Atlantic Canada, 14 in southern Quebec, 30 in southern Ontario, 37 in the Prairies and northern Ontario region and 29 in British Columbia.

Table F.13. Percentiles for Figure 26. National average sulphur dioxide concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2005	0.4	5.1
2006	0.4	4.8
2007	0.3	4.7
2008	0.4	3.6
2009	0.3	3.3
2010	0.3	2.8
2011	0.3	2.9
2012	0.2	2.8
2013	0.2	2.4
2014	0.2	2.4
2015	0.2	2.0
2016	0.1	1.8
2017	0.1	1.4

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2018	0.1	1.4
2019	0.1	1.3

Note: The national average SO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 80 monitoring stations across Canada.

Table F.14. Percentiles for Figure 27. Regional average sulphur dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2005	0.7	5.2	0.9	12.3	1.5	7.8	0.3	1.6	0.4	3.4
2006	0.9	3.8	0.6	8.7	1.1	8.3	0.4	1.5	0.3	4.4
2007	0.5	5.2	0.4	6.7	0.8	8.0	0.2	1.5	0.3	2.8
2008	0.4	3.3	0.4	8.7	0.9	7.7	0.2	1.5	0.5	2.9
2009	0.8	2.0	0.2	4.5	0.6	4.5	0.2	1.4	0.6	3.2
2010	0.3	1.0	0.2	3.5	0.2	3.9	0.1	1.3	0.3	2.7
2011	0.4	1.0	0.1	4.7	0.4	5.3	0.2	1.1	0.3	2.0
2012	0.6	2.4	0.2	6.1	0.3	4.8	0.2	1.1	0.3	2.4
2013	0.3	1.8	0.2	5.4	0.4	4.9	0.2	1.3	0.2	2.2
2014	0.1	2.4	0.4	6.1	0.4	5.1	0.1	1.2	0.2	1.7
2015	0.2	2.0	0.3	5.4	0.3	4.3	0.1	1.0	0.3	1.0
2016	0.2	1.7	0.2	5.8	0.0	3.2	0.0	1.0	0.2	1.0
2017	0.2	1.1	0.1	6.3	0.2	3.6	0.1	1.0	0.2	0.9
2018	0.4	2.0	0.1	5.3	0.2	5.0	0.1	0.9	0.2	0.9
2019	0.4	1.8	0.1	5.5	0.2	4.8	0.1	0.9	0.2	1.0

Note: The regional average SO_2 concentration indicator is based on the annual average of the hourly concentrations recorded at 4 monitoring stations in Atlantic Canada, 9 in southern Quebec, 10 in southern Ontario, 32 in the Prairies and northern Ontario region and 23 in British Columbia.

Table F.15. Percentiles for Figure 29. National peak sulphur dioxide concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion)	90th percentile (parts per billion)
2005	5.0	113.0
2006	5.0	136.0
2007	5.0	81.0
2008	6.0	81.0
2009	5.0	89.0
2010	4.0	82.0
2011	5.0	67.0
2012	5.0	67.0
2013	4.0	71.0
2014	4.0	70.3
2015	3.0	65.7
2016	2.0	55.0
2017	3.0	64.0
2018	2.5	58.0
2019	2.7	52.2

Note: The national peak SO_2 concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 81 monitoring stations across Canada.

Table F.16. Percentiles for Figure 30. Regional peak sulphur dioxide concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2005	23.0	151.0	21.0	216.0	28.0	186.0	6.0	90.0	5.0	84.0
2006	10.0	141.0	10.0	178.0	17.0	197.0	6.0	82.0	4.0	80.0
2007	9.0	113.0	9.0	188.0	14.0	152.0	4.0	75.0	5.0	57.0
2008	9.0	86.0	7.0	163.0	11.0	159.0	5.0	64.0	7.0	60.0
2009	11.0	160.0	5.0	133.0	12.0	120.0	5.0	61.0	6.0	86.0

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2010	3.4	119.1	4.0	218.0	4.0	103.0	4.0	66.0	3.8	59.9
2011	6.7	38.8	7.0	118.0	4.0	87.0	5.0	39.5	3.8	60.1
2012	4.4	52.1	6.0	121.0	5.0	105.0	3.0	56.0	5.0	65.4
2013	6.5	60.9	3.1	95.6	5.1	149.6	4.0	48.0	4.1	65.6
2014	6.7	70.3	4.4	111.8	6.2	168.1	4.0	36.0	4.5	51.5
2015	5.8	46.9	5.2	100.6	6.1	133.0	3.0	36.0	4.1	50.8
2016	6.0	54.1	5.2	102.0	5.4	165.6	2.0	55.0	3.1	32.2
2017	5.0	47.4	4.0	87.8	2.6	90.6	3.0	59.0	3.8	38.9
2018	5.8	67.0	2.4	93.0	2.3	106.3	2.5	38.0	3.0	56.1
2019	5.1	44.1	5.7	88.8	1.5	82.4	2.0	27.0	3.0	31.2

Note: The regional peak SO_2 concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 5 monitoring stations in Atlantic Canada, 9 in southern Quebec, 10 in southern Ontario, 32 in the Prairies and northern Ontario region and 23 in British Columbia.

Table F.17. Percentiles for Figure 32. National average volatile organic compound concentrations, Canada, 2005 to 2019

Year	10th percentile (parts per billion carbon)	90th percentile (parts per billion carbon)
2005	27.1	164.4
2006	27.2	281.9
2007	26.1	173.8
2008	26.8	309.5
2009	28.0	310.1
2010	21.1	231.0
2011	27.2	201.3
2012	20.6	266.3
2013	22.2	258.0
2014	21.9	241.0
2015	24.8	222.7
2016	20.1	176.1

Year	10th percentile (parts per billion carbon)	90th percentile (parts per billion carbon)
2017	25.8	249.3
2018	18.8	102.1
2019	19.9	231.4

Note: The national average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) recorded at 30 monitoring stations across Canada.

Table F.18. Percentiles for Figure 33. Regional average volatile organic compound concentrations, Canada, 2005 to 2019

Year	Atlantic Canada 10th percentile (parts per billion)	Atlantic Canada 90th percentile (parts per billion)	Southern Quebec 10th percentile (parts per billion)	Southern Quebec 90th percentile (parts per billion)	Southern Ontario 10th percentile (parts per billion)	Southern Ontario 90th percentile (parts per billion)	Prairies and northern Ontario 10th percentile (parts per billion)	Prairies and northern Ontario 90th percentile (parts per billion)	British Columbia 10th percentile (parts per billion)	British Columbia 90th percentile (parts per billion)
2005	79.8	278.0	38.3	147.9	23.7	107.3	56.8	357.4	15.9	164.4
2006	77.9	281.9	46.3	137.3	19.9	89.6	55.9	373.6	9.8	471.0
2007	45.3	104.1	37.1	157.3	19.2	98.0	53.2	308.6	10.3	654.6
2008	48.3	309.5	38.5	103.7	18.5	56.6	42.2	467.4	13.0	492.7
2009	46.8	314.9	32.8	94.4	18.9	54.5	42.0	310.1	12.9	736.1
2010	40.3	231.0	37.9	98.8	18.0	63.3	39.7	271.3	10.1	689.3
2011	38.0	201.3	31.6	77.5	17.4	27.2	42.5	260.4	9.4	405.3
2012	38.7	294.3	29.9	69.6	18.8	77.0	39.5	266.3	11.5	288.8
2013	41.1	258.0	27.6	73.6	19.4	68.3	37.3	290.5	13.1	361.3
2014	51.6	241.0	27.7	77.7	20.2	70.4	44.0	292.2	14.7	386.6
2015	47.4	222.7	28.2	89.4	20.2	96.8	38.1	268.9	13.7	353.6
2016	37.1	176.1	26.9	67.8	19.8	52.5	31.9	256.6	11.2	262.1
2017	34.4	315.0	25.8	68.9	16.8	47.3	30.0	249.3	32.2	371.4
2018	31.5	102.0	21.3	60.7	15.6	44.3	36.7	254.2	11.5	277.8
2019	36.4	231.4	23.4	53.7	15.5	40.6	32.1	275.6	10.7	301.8

Note: The regional average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24 hour for urban stations and 4 hour for rural stations) recorded at 4 monitoring stations in Atlantic Canada, 5 in southern Quebec, 9 in southern Ontario, 5 in the Prairies and northern Ontario region and 7 in British Columbia.

Annex G. Mann-Kendall and Sen's pairwise statistical parameters used for the analysis of trends

Table G.1. Legend for tables in Annex G

Field	Description
First year	Starting year of each time series.
Last year	Ending year of each time series.
n	Number of annual values in the calculation, excluding missing values.
Z-test	The absolute value of Z is compared to the standard normal cumulative distribution to define if there is a trend at the selected level α of significance. A positive (negative) value indicates an upward (downward) trend.
Significant	The smallest significance level α at which the test shows that the null hypothesis of no trend can be rejected. For the 3 tested significance levels, the following symbols are used: [A] if trend at α = 0.001 level of significance, [B] if trend at α = 0.01 level of significance, and [C] if trend at α = 0.05 level of significance.
Q	Sen's estimator for the true slope of linear trend, that is, change per unit time period (in this case a year).
Qmin95	The lower limit of the 95% confidence interval of Q (α = 0.05).
Qmax95	The upper limit of the 95% confidence interval of Q (α = 0.05).
B	Estimate of the constant B for the linear trend.
Bmin95	Estimate of the constant Bmin95 for 95% confidence level of a linear trend.
Bmax95	Estimate of the constant Bmax95 for 95% confidence level of a linear trend.
Median change	Percent rate of change per year as described by the Sen's estimator Q divided by the constant B for the linear trend. Slopes expressed in median annual percentage change are relative to the value in the first year of each time series

Table G.2. Mann-Kendall and Sen's tests results for the national and regional average fine particulate matter indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First year	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15
Z-test	1.58	1.58	-2.87	-0.40	1.88	2.57
Significant	**No**	**No**	**Yes[B]**	**No**	**No**	**Yes[C]**
Q	**0.07**	**0.08**	**-0.14**	**-0.01**	**0.20**	**0.20**
Qmin95	-0.02	0.04	-0.18	-0.19	-0.01	0.07
Qmax95	0.14	0.17	-0.03	0.10	0.33	0.39
B	5.94	4.77	8.32	6.63	4.63	4.37
Bmin95	6.52	5.56	8.70	8.52	6.74	5.23

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
Bmax95	5.58	4.28	7.47	5.48	3.83	3.46
Median change	1.17%	1.59%	-1.65%	-0.19%	4.30%	4.52%

Table G.3. Mann-Kendall and Sen's tests results for the national and regional peak (98th percentile) 24-hour fine particulate matter indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia	Northern territories
First year	2005	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019	2019
N	15	15	15	15	15	15	15
Z-test	0.49	-2.18	-3.56	-2.38	3.17	1.98	1.88
Significant	**No**	**Yes[C]**	**Yes[A]**	**Yes[C]**	**Yes[B]**	**Yes[C]**	**No**
Q	**0.16**	**-0.26**	**-0.60**	**-0.58**	**1.36**	**0.48**	**0.57**
Qmin95	-0.31	-0.42	-0.98	-1.10	0.59	-0.01	-0.03
Qmax95	0.82	-0.03	-0.36	-0.13	2.30	2.01	1.22
B	18.75	15.27	24.40	23.86	11.78	14.51	10.92
Bmin95	21.43	16.63	28.37	28.57	14.78	16.03	15.95
Bmax95	13.95	14.32	22.97	20.80	6.38	8.40	9.35
Median change	0.88%	-1.70%	-2.46%	-2.43%	11.51%	3.34%	5.22%

Table G.4. Mann-Kendall and Sen's tests results for the national and regional average ground-level ozone indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia	Northern territories
First year	2005	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15	15
Z-test	1.58	1.39	2.18	-1.39	1.39	0.99	1.09
Significant	**No**	**No**	**Yes[C]**	**No**	**No**	**No**	**No**
Q	**0.06**	**0.07**	**0.19**	**-0.14**	**0.12**	**0.07**	**0.06**
Qmin95	-0.02	-0.06	0.01	-0.24	-0.04	-0.10	-0.12
Qmax95	0.11	0.17	0.30	0.02	0.27	0.26	0.30
B	32.71	32.67	31.45	38.05	32.22	27.16	30.06
Bmin95	33.22	33.23	33.23	39.11	33.47	28.31	31.12
Bmax95	32.27	31.87	30.88	36.42	31.41	25.59	27.37
Median change	0.18%	0.21%	0.61%	-0.37%	0.36%	0.25%	0.18%

Table G.5. Mann-Kendall and Sen's tests results for the national and regional peak (4th-highest) 8-hour ground-level ozone indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia	Northern territories
First year	2005	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15	15
Z-test	-2.77	-2.08	-2.38	-3.07	1.19	-0.59	-1.39
Significant	**Yes[B]**	**Yes[C]**	**Yes[C]**	**Yes[B]**	**No**	**No**	**No**
Q	**-0.51**	**-0.40**	**-0.62**	**-1.01**	**0.20**	**-0.15**	**-0.25**
Qmin95	-0.85	-0.79	-1.20	-1.68	-0.20	-0.52	-0.53
Qmax95	-0.17	-0.09	-0.20	-0.53	0.43	0.34	0.04
B	61.83	54.54	63.58	75.40	56.02	50.52	48.21
Bmin95	63.54	56.96	67.06	81.65	57.86	53.18	51.06
Bmax95	60.14	52.39	59.60	72.98	55.12	48.06	46.26
Median change	-0.82%	-0.74%	-0.98%	-1.34%	0.36%	-0.30%	-0.51%

Table G.6. Mann-Kendall and Sen's tests results for the national and regional average nitrogen dioxide indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First year	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15
Z-test	-4.85	-2.28	-4.35	-4.75	-4.06	-3.86
Significant	**Yes[A]**	**Yes[C]**	**Yes[A]**	**Yes[A]**	**Yes[A]**	**Yes[A]**
Q	**-0.28**	**-0.10**	**-0.42**	**-0.40**	**-0.18**	**-0.26**
Qmin95	-0.36	-0.16	-0.50	-0.53	-0.23	-0.35
Qmax95	-0.22	-0.02	-0.31	-0.28	-0.12	-0.14
B	10.65	4.58	13.07	12.43	8.71	12.19
Bmin95	11.12	4.99	13.44	13.58	8.95	12.64
Bmax95	10.21	4.05	12.39	11.34	8.25	10.86
Median change	-2.67%	-2.11%	-3.23%	-3.18%	-2.03%	-2.11%

Table G.7. Mann-Kendall and Sen's tests results for the national and regional peak (98th percentile) 1-hour nitrogen dioxide indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First year	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15
Z-test	-4.06	-3.07	-2.77	-3.56	-3.37	-2.28
Significant	**Yes[A]**	**Yes[B]**	**Yes[B]**	**Yes[A]**	**Yes[A]**	**Yes[C]**
Q	**-0.67**	**-0.72**	**-0.71**	**-1.02**	**-0.53**	**-0.46**
Qmin95	-0.89	-0.98	-1.26	-1.55	-0.71	-0.77
Qmax95	-0.47	-0.38	-0.19	-0.56	-0.24	-0.06
B	44.65	38.62	51.41	50.52	43.25	39.80
Bmin95	45.97	40.00	55.84	53.72	43.86	42.01
Bmax95	43.58	35.70	45.33	48.51	41.49	36.37
Median change	-1.50%	-1.87%	-1.38%	-2.02%	-1.23%	-1.16%

Table G.8. Mann-Kendall and Sen's tests results for the national and regional average sulphur dioxide indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First year	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15
Z-test	-5.15	-2.38	-4.35	-4.06	-4.16	-3.86
Significant	**Yes[A]**	**Yes[C]**	**Yes[A]**	**Yes[A]**	**Yes[A]**	**Yes[A]**
Q	**-0.09**	**-0.08**	**-0.14**	**-0.19**	**-0.05**	**-0.09**
Qmin95	-0.10	-0.16	-0.20	-0.23	-0.07	-0.11
Qmax95	-0.08	-0.03	-0.08	-0.15	-0.03	-0.07
B	1.91	1.63	2.79	3.85	1.15	2.05
Bmin95	1.99	2.46	3.28	3.96	1.22	2.18
Bmax95	1.75	1.23	2.30	3.37	0.82	1.77
Median change	-4.93%	-4.62%	-4.85%	-5.05%	-4.76%	-4.62%

Table G.9. Mann-Kendall and Sen's tests results for the national and regional peak (99th percentile) 1-hour sulphur dioxide indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First year	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15
Z-test	-4.75	-3.37	-4.16	-3.66	-2.97	-3.66
Significant	**Yes[A]**	**Yes[A]**	**Yes[A]**	**Yes[A]**	**Yes[B]**	**Yes[A]**
Q	**-2.39**	**-3.69**	**-2.57**	**-2.76**	**-2.64**	**-1.76**
Qmin95	-2.95	-5.18	-3.76	-3.69	-4.05	-2.35
Qmax95	-1.86	-1.49	-1.84	-1.82	-1.05	-1.04
B	51.76	65.22	62.59	70.84	51.54	42.56
Bmin95	54.07	77.71	73.88	80.57	57.29	46.50
Bmax95	46.93	47.07	55.99	62.92	34.13	37.10
Median change	-4.61%	-5.66%	-4.11%	-3.90%	-5.12%	-4.13%

Table G.10. Mann-Kendall and Sen's tests results for the national and regional average volatile organic compounds indicators

Statistic	National	Atlantic Canada	Southern Quebec	Southern Ontario	Prairies and northern Ontario	British Columbia
First year	2005	2005	2005	2005	2005	2005
Last year	2019	2019	2019	2019	2019	2019
n	15	15	15	15	15	15
Z-test	-3.66	-2.18	-4.26	-3.17	-3.86	-2.28
Significant	**Yes[A]**	**Yes[C]**	**Yes[A]**	**Yes[B]**	**Yes[A]**	**Yes[C]**
Q	**-3.20**	**-3.50**	**-3.31**	**-1.59**	**-2.85**	**-3.54**
Qmin95	-3.98	-6.89	-4.64	-2.30	-4.19	-6.85
Qmax95	-2.28	-0.71	-2.25	-0.64	-1.56	-1.21
B	104.57	134.50	79.83	49.67	129.95	137.42
Bmin95	109.23	155.18	89.02	55.36	139.68	165.29
Bmax95	97.41	105.73	69.40	41.95	120.16	114.59
Median change	-3.06%	-2.60%	-4.15%	-3.19%	-2.20%	-2.58%

Annex H. Monitoring stations used for the urban area indicators

Table H.1. List of monitoring stations used in the calculation of the urban area indicators, 2005 to 2019

Urban area (population centre)	NAPS ID	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide
St. John's	10102	X	X	X	X	X	X
St. John's	10401	X	X	X	X	X	X
Charlottetown	20104	X	X	X	X	X	X
Halifax	30113	X	X	X	X	X	X
Halifax	30118	n/a	n/a	X	X	X	X
Halifax	30120	X	X	X	X	X	X
Fredericton	40103	X	X	X	X	X	X
Fredericton	40104	X	X	X	X	X	X
Quebec	50308	X	X	X	X	X	X
Quebec	50310	X	X	X	X	X	X
Quebec	50311	X	X	X	X	X	X
Quebec	55701	n/a	n/a	X	X	n/a	n/a
Quebec	55702	X	X	X	X	X	X
Montreal	50103	X	X	X	X	X	X
Montreal	50104	n/a	n/a	X	X	X	X
Montreal	50105	X	X	n/a	n/a	n/a	n/a
Montreal	50109	X	X	X	X	X	X
Montreal	50110	X	X	X	X	X	X
Montreal	50113	X	X	X	X	X	X
Montreal	50115	n/a	n/a	X	X	X	X
Montreal	50116	n/a	n/a	X	X	X	X
Montreal	50119	X	X	X	X	X	X
Montreal	50121	X	X	X	X	X	X
Montreal	50122	X	X	X	X	X	X
Montreal	50126	X	X	X	X	X	X
Montreal	50128	X	X	X	X	X	X
Montreal	50129	X	X	X	X	X	X
Montreal	50131	X	X	n/a	n/a	n/a	n/a
Montreal	50133	X	X	n/a	n/a	X	X
Montreal	50134	X	X	X	X	X	X
Montreal	50135	X	X	X	X	X	X
Montreal	50136	X	X	X	X	X	X
Montreal	50137	X	X	X	X	X	X
Montreal	50138	X	X	X	X	X	X

Urban area (population centre)	NAPS ID	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide
Gatineau	50204	X	X	X	X	X	X
Ottawa	60104	X	X	X	X	X	X
Ottawa	60106	X	X	X	X	X	X
Oshawa	61701	n/a	n/a	X	X	n/a	X
Oshawa	61702	X	X	X	X	X	X
Oshawa	61703	X	X	X	X	X	X
Toronto	60410	X	X	X	X	X	X
Toronto	60421	X	X	X	X	X	X
Toronto	60428	X	X	X	X	X	X
Toronto	60429	X	X	X	X	X	X
Toronto	60430	X	X	X	X	X	X
Toronto	60433	X	X	X	X	X	X
Toronto	60434	X	X	X	X	X	X
Toronto	60435	X	X	X	X	X	X
Toronto	60438	X	X	X	X	X	X
Toronto	60439	X	X	X	X	X	X
Toronto	60440	X	X	X	X	X	X
Toronto	60450	X	X	X	X	X	X
Toronto	61603	X	X	X	X	X	X
Toronto	65101	X	X	X	X	X	X
Barrie	65001	X	X	X	X	X	X
Hamilton	60512	X	X	X	X	X	X
Hamilton	60513	X	X	X	X	X	X
Hamilton	60515	X	X	X	X	X	X
Hamilton	60521	X	X	X	X	X	X
Hamilton	63001	X	X	X	X	X	X
St. Catharines – Niagara Falls	61302	X	X	X	X	X	X
Kitchener	61502	X	X	X	X	X	X
London	60903	X	X	X	X	X	X
London	60904	X	X	X	X	X	X
Windsor	60204	X	X	X	X	X	X
Windsor	60211	X	X	X	X	X	X
Winnipeg	70118	X	X	X	X	X	X
Winnipeg	70119	X	X	X	X	X	X
Regina	80110	X	X	X	X	X	X
Regina	80111	X	X	X	X	X	X
Saskatoon	80211	X	X	X	X	X	X

Urban area (population centre)	NAPS ID	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide
Calgary	90222	X	X	X	X	X	X
Calgary	90227	X	X	X	X	X	X
Calgary	90228	X	X	X	X	X	X
Calgary	90229	X	X	X	X	X	X
Calgary	90230	X	X	X	X	X	X
Calgary	90235	X	X	X	X	X	X
Edmonton	90120	X	X	X	X	X	X
Edmonton	90121	X	X	X	X	X	X
Edmonton	90130	X	X	X	X	X	X
Edmonton	90132	X	X	n/a	n/a	n/a	n/a
Edmonton	90133	X	X	X	X	X	X
Edmonton	90134	X	X	X	X	X	X
Edmonton	90135	X	X	X	X	X	X
Edmonton	90136	X	X	X	X	X	X
Vancouver	100103	X	X	X	X	X	X
Vancouver	100110	X	X	X	X	X	X
Vancouver	100111	X	X	X	X	X	X
Vancouver	100112	n/a	n/a	X	X	X	X
Vancouver	100119	X	X	X	X	X	X
Vancouver	100121	X	X	X	X	X	X
Vancouver	100125	X	X	X	X	X	X
Vancouver	100126	n/a	n/a	X	X	X	X
Vancouver	100127	X	X	X	X	X	X
Vancouver	100128	X	X	X	X	X	X
Vancouver	100132	X	X	X	X	X	X
Vancouver	100134	X	X	X	X	X	X
Vancouver	100135	n/a	n/a	X	X	X	X
Vancouver	100138	X	X	n/a	n/a	n/a	n/a
Vancouver	100140	X	X	X	X	X	X
Vancouver	100141	X	X	X	X	X	X
Vancouver	101202	X	X	X	X	X	X
Vancouver	101301	X	X	X	X	X	X
Vancouver	101501	n/a	n/a	X	X	X	X
Victoria	100304	X	X	X	X	X	X
Victoria	100308	X	X	X	X	X	X
Whitehorse	119003	X	X	X	X	X	X
Whitehorse	119004	X[A]	X	X	X	X[A]	X[A]

Urban area (population centre)	NAPS ID	Average fine particulate matter	Peak fine particulate matter	Average ozone	Peak ozone	Average nitrogen dioxide	Peak nitrogen dioxide
Yellowknife	129003	X	X	X	X	X	X

Note: X = station was used in the calculation of the air quality indicator at the urban area level. n/a = not applicable. [A] Station only reported concentrations to 2018. For the indicator, the 2018 concentration value was used for 2019.

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